BART-San Francisco Airport Extension Project [1995]
Draft Environmental Impact Report/
Supplemental Draft Environmental Impact Statement

Transportation Technical Report

(Transportation Projections and Analysis Methodology Memorandum)

Prepared for:

BART/SamTrans
Ogden Environmental and Energy Services Company

Prepared by:

Parsons Brinckerhoff Quade & Douglas, Inc.
303 Second Street, Suite 700N
San Francisco, CA 94708

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1.0 INTRODUCTION

1.1 PURPOSE OF TECHNICAL MEMORANDUM

This report describes the methods used in developing traffic, transit, and parking projections for the BART/SFO Airport Extension Draft Environmental Impact Report and Supplemental Draft Environmental Impact Statement. Its purpose is to provide background information explaining how the projections and findings of the project were derived.

The methods described in this report represent an extension and improvement of the methods used for traffic and parking projections in the BART-SFIA Extension Alternatives Analysis/Draft Environmental Impact Statement/Report completed in March 1992. At the conclusion of that project, several requests were received from local cities and other agencies to evaluate the impact of the BART-SFIA extension on additional intersections, to use more recent traffic counts, to consider the effect of additional or new projects on traffic congestion (such as the proposed San Francisco International Airport Master Plan development), and to reassess the distribution of BART patron parking among the various extension stations to determine if proposed station parking capacities were sufficient. The methods presented in this memorandum address each of these requests and concerns.

1.2 ALTERNATIVES EVALUATED

The nine alternatives evaluated for this project are described below. For a more detailed description of the alternatives, see Chapter 1 in the Draft Environmental Impact Report.

Proposed Project: Locally Preferred Alternative (LPA)

The Proposed Project, the Locally Preferred Alternative (LPA), includes a three-station BART extension to an intermodal airport station on the CalTrain right-of-way west of Highway 101 opposite the San Francisco International Airport (SFIA). The three stations on the extension are the Hickey, Tanforan, and Airport Intermodal stations. The Airport Intermodal station would offer cross-platform transfers between BART, CalTrain, and the Airport Light Rail System (ALRS). All improvements assumed in Alternative II (TSM) are also included in this alternative.

The proposed project is similar to Alternative 5A from the BART-San Francisco Airport Extension Alternatives Analysis/Draft Environmental Impact Statement/Draft Environmental Impact Report complete in March 1992. The exception is that the Airport Intermodal BART station would

not allow access from the west side for either automobiles, buses or pedestrians.

Alternative I: No-Build

Alternative I (No-Build) assumes no major changes to transportation facilities in the BART extension study area or in the 9-County Bay Area compared to 1993 conditions. The earthquake-damaged section of I-280 in San Francisco is assumed to be back in operation in Alternative I for all analysis years. In addition, the Colma BART station, which is currently under construction and planned for completion in 1995, is assumed to be build in the 1998, 2000, and 2010 No-Build scenarios. BART service frequencies are assumed to stay the same as existing with 3.75 minute headways through the Transbay Tube. The Colma station is not assumed for the 1993 No-Build scenario since it was not in operation by that year. All other features of the No-Build Alternative are the same as existed in 1993, including CalTrain service at 60 trains per day.

Alternative II: Transportation Systems Management (TSM)

The TSM Alternative includes a number of planned or proposed transportation improvements around the Bay Area. Within the BART-SFIA extension study area, this alternative includes: the Colma BART station, increased BART service to 2.25 minute headways through the Transbay Tube and 4.5 minute headways south of the Daly City BART station, increased CalTrain service to 86 daily trains with a new SFIA CalTrain station west of Highway 101 connected to airport terminal and employment areas by the proposed ALRS, and construction of the Hickey Boulevard extension in South San Francisco with a new Highway 101 interchange at Oyster Point.

Other transportation improvements around the Bay Area include; replacement of all earthquake damaged freeways (I-280, the Embarcadero and Central freeways in San Francisco, and the Cypress structure in Oakland) with roadway facilities that match their pre-earthquake traffic capacities; and construction of the MUNI Metro extension to connect with the Fourth and Townsend CalTrain terminus station in San Francisco.

Alternative III: Base Case

Alternative III (Base Case) is similar to the Proposed Project (LPA) except for the following; the station in South San Francisco would be located about 3/4 miles further south at Chestnut Avenue rather than at Hickey Boulevard; the Airport Intermodal BART station would allow access from the west side for automobiles and buses via Center Street, and pedestrians from west-side neighborhoods could access the station from San Antonio Avenue in San Bruno; and the track alignment would be slightly shorter than for the

Proposed Project between the Tanforan and Airport Intermodal BART stations. All improvements assumed in Alternative II (TSM) are also included in this alternative.

Alternative III is identical to Alternative 3A from the BART-San Francisco Airport Extension Alternatives Analysis/Draft Environmental Impact Statement/Draft Environmental Impact Report complete in March 1992.

Alternative IV: Airport Aerial East of Highway 101

Alternative IV (Airport Aerial East of Highway 101) includes a four-station BART extension to the Millbrae Intermodal BART station on the CalTrain right-of-way at Center Street in Millbrae. The four stations on the extension are the Hickey, Tanforan or I-380/San Bruno, Airport Long-Term Parking, and Millbrae Intermodal BART stations. Two possible locations are included for the second station on the extension. One option is the Tanforan site assumed for the Proposed Project, and the second option is just south of I-380 and east of the CalTrain tracks in San Bruno.

Both the I-380/San Bruno and Millbrae Intermodal BART stations would provide cross-platform transfers with CalTrain, and the Airport Long-Term Parking and Millbrae Intermodal stations would provide connections to the ALRS. All improvements assumed in Alternative II (TSM) are also included in this alternative.

Alternative V: Minimum Length Subway to Millbrae Intermodal

Alternative V (Minimum Length Subway to Millbrae Intermodal) includes a three-station BART extension to the Millbrae Intermodal BART station on the CalTrain right-of-way at Center Street in Millbrae. The three stations on the extension are the Hickey, Tanforan or I-380/San Bruno or Downtown San Bruno, and Millbrae Intermodal BART stations. As indicated, three possible locations are included for the second station on the extension. One option is the Tanforan site assumed for the Proposed Project, a second option is just south of I-380 on the CalTrain right-of-way (ROW) in San Bruno, and the third option is just south of San Bruno Avenue on the CalTrain ROW in downtown San Bruno.

Both the I-380/San Bruno and Millbrae Intermodal BART stations would provide cross-platform transfers with CalTrain, and the Millbrae Intermodal station would provide a connection to the ALRS. All improvements assumed in Alternative II (TSM) are also included in this alternative.

Alternative V-A: Minimum Length Subway to Airport GTC

Alternative V-A (Minimum Length Subway to Airport GTC) includes a three-station BART extension to the San Francisco International Airport Ground Transportation Center (GTC).

The three stations on the extension are the Hickey, I-380/San Bruno or Downtown San Bruno, and the Airport GTC BART stations. As indicated, two possible locations are included for the second station on the extension. One option is just south of I-380 on the CalTrain right-of-way (ROW) in San Bruno, and the second option is just south of San Bruno Avenue on the CalTrain ROW in downtown San Bruno.

The I-380/San Bruno station would provide a cross-platform transfer with CalTrain and with the ALRS, and the Airport GTC station would also provide a connection to the ALRS. All improvements assumed in Alternative II (TSM) are also included in this alternative.

<u>Alternative V-B: Minimum Length Subway to San Bruno</u>

Alternative V-B (Minimum Length Subway to San Bruno) includes a two-station BART extension to San Bruno. The two stations on the extension are the Hickey and the I-380/San Bruno or Downtown San Bruno stations. The BART stations are identical to those described for Alternative V-A with the exception that the last station (Airport GTC station) is not included. As with Alternative V-A, two possible locations are included for the second station on the extension. One option is just south of I-380 on the CalTrain right-of-way (ROW) in San Bruno, and the second option is just south of San Bruno Avenue on the CalTrain ROW in downtown San Bruno.

The I-380/San Bruno station would provide a cross-platform transfer with CalTrain and with the ALRS. All improvements assumed in Alternative II (TSM) are also included in this alternative.

<u>Alternative VI: Millbrae Avenue via Airport International Terminal</u>

Alternative VI (Millbrae Avenue via Airport International Terminal) includes a four-station BART extension to Millbrae Avenue in Millbrae. The four stations on the extension are the Hickey, Tanforan, Airport International Terminal, and the Millbrae Avenue BART stations. In this alternative, the Tanforan station is located just west of Huntington Avenue on the eastern Tanforan Shopping Center Parking lot.

The Millbrae Avenue station would provide transfer opportunities with CalTrain, and the Airport International Terminal Station would provide connections with the ALRS. All improvements assumed in Alternative II (TSM) are also included in this alternative.

1.3 ANALYSIS YEARS

Transportation analysis was performed for three time periods as follows:

- 1993 Base Year
- 1998 Year of Opening
- 2010 Horizon Year

In addition, certain traffic analyses were completed for the year 2000 as input into the air quality analysis.

1.4 STUDY AREA

The BART-SFIA extension study area consists of the northern half of San Mateo County. Detailed traffic and transit evaluations focused primarily on the area bounded by the San Mateo-San Francisco County Line to the north, Highway 1 and I-280 to the west, the San Francisco Bay to the east, and south to the southern limits of the City of San Mateo. Within this area, the analysis emphasized locations that would be affected by one or more of the BART extension alternatives, including station areas, approaches to stations (including freeways and major arterials), and other locations along the BART alignment.

2.0 TRAFFIC, TRANSIT, AND PARKING PROJECTIONS METHODOLOGY

Traffic, transit and parking projections were developed for each project alternative. Traffic projections were developed for the three planning years; 1993 (base year), 1998 (year of opening), and 2010 (horizon year), as well as for the year 2000 which was required for assessment of air quality impacts. Transit projections were developed for the three planning years (1993, 1998, and 2010). Parking estimates were developed just for the year 2010 due to the fact this information was relevant only for station design considerations which are based on 2010 conditions. The methods used to develop the projections are presented on the following pages.

2.1 METROPOLITAN TRANSPORTATION COMMISSION (MTC) MODE-CHOICE AND HIGHWAY MODEL PROJECTIONS

2.1.1 Travel Volume Projections

The foundation of all traffic, transit and parking projections developed during this study are the travel projections developed by the Metropolitan Transportation Commission (MTC) modeling department.

MTC has developed "trip tables" representing the entire nine-county Bay Area. These trip tables, which were created independently from the BART/SFO Airport Extension Draft Environmental Impact Report and Supplemental Draft Environmental Impact Statement project, utilize Association of Bay Area Governments (ABAG) projections for employment and population growth in each of 700 zones covering the entire Bay Area. MTC converts the population and employment projections into daily person trip ends (i.e. the number of trips originating or destined to each zone). This is done by estimating the number of trips that would be generated to or from each zone considering the types and volumes of persons associated with each projected activity in that zone (e.g. residential, employment, retail, etc.). A "gravity distribution" model is then employed to connect the trip ends, or, in other words, to estimate specifically how many persons living in Zone "X" are travelling to Zone "Y."

The results of this process are the trip tables. Trip tables are simply 700x700 matrices that specify the number of people travelling between each possible zone pair in the region. Trip tables were available for the years 1990 and 2010 for Home-Based Work, Home-Based Shopping, Home-Based Social/Recreational, and Non-Home-Based trip purposes.

For this study, the MTC trip tables used were based on the following ABAG demographic projections:

- o For year 1990 trip tables, ABAG Projections '92 estimates were used. Projections '92 represents the latest projections available from ABAG and includes the latest updated information from the 1990 Census.
- o For year 2010 trip tables, ABAG Projections '90 estimates were used (year 2010 trip tables based on ABAG's Projections '92 were not available within the time frame of this study). These are the same trip tables used during the BART-San Francisco Airport Extension Alternatives Analysis/DEIS/DEIR completed in March 1992 and their use in this study assures greater comparability between the current study and earlier projections completed as part of the BART extension project. The 2010 trip tables are based on estimates that do not include information from the 1990 Census, nor the latest information from cities in the study area with regard to proposed future land use developments. For this reason, additional adjustments to year 2010 trip tables were required (see Sections 2.1.3 and 2.1.4).

San Francisco International Airport (SFIA) air passenger trips were estimated separately from the MTC travel projections discussed above. During the BART-San Francisco Airport Extension Alternatives Analysis/DEIS/DEIR, 1990 and 2010 volumes and origins of SFIA air passengers requiring land access (i.e. made their trip to SFIA from some origin off airport property) were estimated based on the SFIA Master Plan projections and other survey data available from the airport.

Table 2.1 displays a summary of the regionwide travel volumes in the trip tables for 1990 and as projected for 2010.

2.1.2 Mode-Choice Travel Projections

Using the trip tables described above, MTC ran its regional mode-choice and highway assignment models. These models have been employed largely because they have been accepted by the Federal Transit Administration (FTA) for this project and have also achieved regional acceptance by virtue of their having been used in most major transit planning projects in the Bay Area.

For each project alternative, the model estimates "mode-split" travel volumes (i.e., the number of travellers who would use any specific mode to make their trip, including transit, drive-alone auto, and carpool). If they are projected to use some form of public transit, the model estimates which boarding point travellers would use (e.g.

TABLE 2.1
REGIONAL TRAVEL PROJECTIONS
DAILY VOLUMES
1990 AND 2010

TRIP PURPOSE	1990	2010	PERCENT GROWTH
Home-Based Work	4,334,949	5,383,943	+ 24.2
Non-Work (1)	12,405,704	16,032,639	+ 29.2
SUBTOTAL	16,740,653	21,416,582	+ 27.9
SFIA Air Passengers (2)	95,300	149,000	+ 56.3

Source: Metropolitan Transportation Commission, Regional Person Trips Tables, October 1993, and SFIA Air Passenger Projections, March 1992

(1) Includes the Shopping, Social/Recreational, and Non-Home-Based trip purposes.
(2) Projections derived from the SFIA Master Plan as originally estimated during the BART-San Francisco Airport Extension Alternatives Analysis/DEIS/DEIR, March 1992. Includes "meeters and greeters" as well as air passengers.

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which BART station) and how they would access the transit boarding point (e.g. would they walk, drive or take a bus to a BART station). If they are projected to make their entire trip by auto, the model estimates the most likely route taken and, therefore, estimates the volume of traffic on key roadways in the study area such as Highway 101. The outcomes of the model runs are, therefore, estimates of how each alternative would affect the travel behavior of persons in the region.

Several alternative scenarios were not modeled by MTC during this study. Two of the alternatives studied, Alternative II (TSM) and Alternative III (Base Case) were identical to alternatives evaluated during the BART-San Francisco Airport Extension Alternatives Analysis/DEIS/DEIR study, and the model results completed during that study were still valid. Also, MTC did not model every alternative using the 1990 trip tables. Instead, model runs were completed for the 1990 Alternative I (No-Build) and Proposed Project (LPA) scenarios, and this information was used to manually estimated the base year (1993) travel projections for the remaining 1990 alternatives. Table 2.2 indicates which

TABLE 2.2
MTC MODEL RUNS CONDUCTED

ALTERNATIVE		TRIP TABLES USED 1990	2010
Proposed Project (LPA)		X	X
I	No-Build	X	X
II	TSM		X (1)
III	Base Case		X (1)
IV	Airport Aerial East of Highway 101		X
V	Minimum Length Subway to Millbrae Intermodal		X
V-A	Minimum Length Subway to Airport GTC		X
V-B	Minimum Length Subway to San Bruno		X
VI	Millbrae Avenue via Airport International Terminal		X

(1) Model results available from the BART-San Francisco Airport Extension Alternatives Analysis/DEIS/DEIR, March 1992

scenarios were modeled by MTC, and Section 2.2.2 discusses how these results were used to estimate travel volumes for the remaining scenarios.

Mode-choice estimates for SFIA air passenger were developed independently from the regional MTC mode-choice model. Mode-choice estimates for air passengers developed during the BART-San Francisco Airport Extension Alternatives Analysis/DEIS/DEIR were the basis for new estimates created as part of this study. MTC reviewed this earlier work, and based on the model inputs used then, conducted a manual estimation of SFIA air passenger for each of the new alternatives included in this study.

2.1.3 Adjustments to the MTC Model Results

After reviewing the initial MTC model results, it was determined that some further adjustment would be required to correct for certain inconsistencies. In particular, the following adjustments were required:

- The model runs completed during the BART-San Francisco Airport Extension Alternatives Analysis/DEIS/DEIR for Alternatives II and III were slightly inconsistent with the later model runs in terms of number of travellers assigned to transit versus automobile modes. Adjustments were made to correct for these inconsistencies using the Proposed Project (LPA) as the basis for establishing the amount of adjustment needed.
- The 2010 home-based work trip tables use to project results for Alternatives I, IV, V, V-A, V-B, and VI were determined to have an undercounting of trips to SFIA compared to the Proposed Project, and Alternatives II and III. Adjustments were made to the travel projections for these undercounted work trips using the Proposed Project (LPA) to establish the amount of adjustment needed.
- The MTC trip tables included a surrogate group of travellers (in the home-based shopping trip purpose category) originally intended to simulate volumes of air passengers to SFIA. Because SFIA air passengers were separately estimated for this study, the surrogate air passengers had to be removed. In consultation with MTC, 90 percent of home-based shopping trips to the SFIA zone were removed from the MTC estimates.

Table 2.3 shows the pre-adjustment MTC model results for home-based work and non-work trip purposes. Table 2.4 shows the projected travel volumes after the adjustments were made. In Table 2.4, the shaded areas indicate those values that were changed.

The adjustments shown on Table 2.4 were also reflected in other MTC model-generated projections, including BART station entries and exits, transit operator boardings, BART ridership to the airport, and other transit information presented in the EIR and EIS. Each of these other projections were adjusted to account for the model-generated inconsistencies.

It should be noted that some additional adjustments were made to MTC mode-choice model projections as a result of more detailed analysis conducted by the study team. This second class of adjustments were made to refine the MTC model projections, mostly in those areas where a regional model does not contain sufficient detail to estimate more localized effects. For instance, the MTC model projected that all BART passengers to SFIA would have to transfer to

TABLE 2.3
BART–SFO AIRPORT EXTENSION PROJECT DEIR/SEIS
MTC TRIP TABLES (ORIGINAL)

TRIP PURPOSE	No–Build 1990	LPA 1990	No–Build 2010	TSM 2010	LPA 2010	III Base Case 2010	IV E of 101 2010	V Mill Int 2010	V–A GTC 2010	V–B Stage I 2010	VI Mill Ave 2010
Home–Based Work											
Transit	482,189	493,042	591,155	597,040	603,251	603,947	600,786	601,379	600,606	600,679	601,416
SR3	226,762	226,167	305,644	310,523	309,991	309,994	309,063	309,041	309,067	309,099	309,056
SR2	583,798	581,809	715,382	718,840	717,505	717,309	715,250	715,110	715,325	715,296	715,061
DA	3,042,200	3,033,931	3,753,152	3,757,540	3,753,196	3,752,693	3,740,234	3,739,803	3,740,335	3,740,259	3,739,800
Auto Subtotal	3,852,760	3,841,907	4,774,178	4,786,903	4,780,692	4,779,996	4,764,547	4,763,954	4,764,727	4,764,654	4,763,917
Total	4,334,949	4,334,949	5,365,333	5,383,943	5,383,943	5,383,943	5,365,333	5,365,333	5,365,333	5,365,333	5,365,333
HBW to SFO Only											
Transit	2,186	4,171	2,698	6,894	7,628	7,678	4,630	4,485	4,135	4,575	4,068
SR3	2,042	1,747	2,278	3,108	3,033	3,033	2,013	2,026	2,043	2,023	2,045
SR2	4,433	4,046	4,699	6,586	6,441	6,423	4,246	4,288	4,370	4,255	4,396
DA	22,580	21,277	23,884	35,581	35,067	35,035	22,670	22,760	23,011	22,706	23,050
Auto Subtotal	29,055	27,070	30,861	45,275	44,541	44,491	28,929	29,074	29,424	28,984	29,491
Total	31,241	31,241	33,559	52,169	52,169	52,169	33,559	33,559	33,559	33,559	33,559
Non–Work											
SHTR	181,086	181,856	234,017	230,118	231,774	230,003	236,072	235,969	236,009	236,014	235,992
SHA	4,644,063	4,643,293	5,690,779	5,694,678	5,693,022	5,694,793	5,688,724	5,688,827	5,688,787	5,688,782	5,688,804
SH Subtotal	4,825,149	4,825,149	5,924,796	5,924,796	5,924,796	5,924,796	5,924,796	5,924,796	5,924,796	5,924,796	5,924,796
SRTR	109,186	109,320	129,680	128,935	129,351	128,975	129,890	129,898	129,925	129,896	129,898
SRA	2,489,266	2,489,132	3,196,174	3,196,919	3,196,503	3,196,879	3,195,964	3,195,956	3,195,929	3,195,958	3,195,956
SR Subtotal	2,598,452	2,598,452	3,325,854	3,325,854	3,325,854	3,325,854	3,325,854	3,325,854	3,325,854	3,325,854	3,325,854
NHBTR	211,912	212,390	308,701	306,035	307,007	306,149	309,704	309,706	309,737	309,688	309,718
NHBA	4,812,898	4,812,420	6,538,092	6,540,758	6,539,786	6,540,644	6,537,089	6,537,087	6,537,056	6,537,105	6,537,075
NHB Subtotal	5,024,810	5,024,810	6,846,793	6,846,793	6,846,793	6,846,793	6,846,793	6,846,793	6,846,793	6,846,793	6,846,793
Transit Subtotal	502,184	503,566	672,398	665,088	668,132	665,127	675,666	675,573	675,671	675,598	675,608
Auto Subtotal	11,946,227	11,944,845	15,425,045	15,432,355	15,429,311	15,432,316	15,421,777	15,421,870	15,421,772	15,421,845	15,421,835
Total	12,448,411	12,448,411	16,097,443	16,097,443	16,097,443	16,097,443	16,097,443	16,097,443	16,097,443	16,097,443	16,097,443
NW to SFO Only											
SHTR	468	5[illegible]8	1,855	2,170	2,757	2,025	2,589	2,479	2,462	2,534	2,489
SHA	46,984	46,754	70,149	69,834	69,247	69,979	69,415	69,525	69,542	69,470	69,515
SH Subtotal	47,452	47,452	72,004	72,004	72,004	72,004	72,004	72,004	72,004	72,004	72,004
SRTR	4	7	29	31	35	32	32	32	32	32	32
SRA	1,219	1,216	2,614	2,612	2,608	2,613	2,611	2,611	2,611	2,611	2,611
SR Subtotal	1,223	1,223	2,643	2,643	2,643	2,643	2,643	2,643	2,643	2,643	2,643
NHBTR	281	327	491	527	588	515	548	533	535	542	532
NHBA	19,178	19,132	25,165	25,129	25,068	25,141	25,108	25,123	25,121	25,114	25,124
NHB Subtotal	19,459	19,459	25,656	25,656	25,656	25,656	25,656	25,656	25,656	25,656	25,656
Transit Subtotal	753	1,032	2,375	2,728	3,380	2,570	3,169	3,044	3,029	3,108	3,053
Auto Subtotal	67,381	67,102	97,928	97,575	96,923	97,733	97,134	97,259	97,274	97,195	97,250
Total	68,134	68,134	100,303	100,303	100,303	100,303	100,303	100,303	100,303	100,303	100,303

TABLE 2.4
BART–SFO AIRPORT EXTENSION PROJECT DEIR/SEIS
MTC TRIP TABLES (ADJUSTED)

TRIP PURPOSE	No–Build 1990	LPA 1990	No–Build 2010	TSM 2010	LPA 2010	III Base Case 2010	IV E of 101 2010	V Mill Int 2010	V–A GTC 2010	V–B Stage I 2010	VI Mill Ave 2010
Home–Based Work											
Transit	482,189	493,042	593,151	597,040	603,251	603,947	603,854	604,366	603,399	603,716	604,172
SR3	226,762	226,167	306,872	310,523	309,991	309,994	310,144	310,130	310,164	310,186	310,155
SR2	583,798	581,809	717,913	718,840	717,505	717,309	717,530	717,413	717,673	717,581	717,424
DA	3,042,200	3,033,931	3,766,007	3,757,540	3,753,196	3,752,693	3,752,415	3,752,034	3,752,707	3,752,460	3,752,192
Auto Subtotal	3,852,760	3,841,907	4,790,792	4,786,903	4,780,692	4,779,996	4,780,089	4,779,577	4,780,544	4,780,227	4,779,771
Total	4,334,949	4,334,949	5,383,943	5,383,943	5,383,943	5,383,943	5,383,943	5,383,943	5,383,943	5,383,943	5,383,943
HBW to SFO Only											
Transit	2,186	4,171	4,694	6,894	7,628	7,678	7,698	7,472	6,928	7,612	6,824
SR3	2,042	1,747	3,506	3,108	3,033	3,033	3,094	3,115	3,140	3,110	3,144
SR2	4,433	4,046	7,230	6,586	6,441	6,423	6,526	6,591	6,718	6,540	6,759
DA	22,580	21,277	35,739	35,581	35,067	35,035	34,851	34,991	35,383	34,907	35,442
Auto Subtotal	29,055	27,070	47,475	45,275	44,541	44,491	44,471	44,697	45,241	44,557	45,345
Total	31,241	31,241	52,169	52,169	52,169	52,169	52,169	52,169	52,169	52,169	52,169
Non–Work											
SHTR	180,665	196,039	228,897	228,165	229,293	229,161	231,214	231,403	231,048	231,158	231,334
SHA	4,601,777	4,586,403	5,631,095	5,631,827	5,630,699	5,630,831	5,628,778	5,628,589	5,628,944	5,628,834	5,628,658
SH Subtotal	4,782,442	4,782,442	5,859,992	5,859,992	5,859,992	5,859,992	5,859,992	5,859,992	5,859,992	5,859,992	5,859,992
SRTR	109,186	118,254	127,755	128,935	129,351	129,529	128,484	128,600	128,400	128,465	128,554
SRA	2,489,266	2,480,198	3,198,099	3,196,919	3,196,503	3,196,325	3,197,370	3,197,254	3,197,454	3,197,389	3,197,300
SR Subtotal	2,598,452	2,598,452	3,325,854	3,325,854	3,325,854	3,325,854	3,325,854	3,325,854	3,325,854	3,325,854	3,325,854
NHBTR	211,912	229,749	304,118	306,035	307,007	307,464	306,353	306,613	306,101	306,276	306,514
NHBA	4,812,898	4,795,061	6,542,675	6,540,758	6,539,786	6,539,329	6,540,440	6,540,180	6,540,692	6,540,517	6,540,279
NHB Subtotal	5,024,810	5,024,810	6,846,793	6,846,793	6,846,793	6,846,793	6,846,793	6,846,793	6,846,793	6,846,793	6,846,793
Transit Subtota	501,763	544,042	660,770	663,135	665,651	666,154	666,051	666,616	665,549	665,899	666,402
Auto Subtotal	11,903,941	11,861,662	15,371,869	15,369,504	15,366,988	15,366,485	15,366,588	15,366,023	15,367,090	15,366,740	15,366,237
Total	12,405,704	12,405,704	16,032,639	16,032,639	16,032,639	16,032,639	16,032,639	16,032,639	16,032,639	16,032,639	16,032,639
NW to SFO Only											
SHTR	47	70	185	217	276	202	259	248	246	253	249
SHA	4,698	4,675	7,015	6,983	6,924	6,998	6,941	6,952	6,954	6,947	6,951
SH Subtotal	4,745	4,745	7,200	7,200	7,200	7,200	7,200	7,200	7,200	7,200	7,200
SRTR	4	7	29	31	35	32	32	32	32	32	32
SRA	1,219	1,216	2,614	2,612	2,608	2,613	2,611	2,611	2,611	2,611	2,611
SR Subtotal	1,223	1,223	2,643	2,643	2,643	2,643	2,643	2,643	2,643	2,643	2,643
NHBTR	281	327	491	527	548	515	548	533	535	542	532
NHBA	19,178	19,132	25,165	25,123	25,068	25,141	25,108	25,123	25,121	25,114	25,124
NHB Subtotal	19,459	19,459	25,656	25,656	25,656	25,656	25,656	25,656	25,656	25,656	25,656
Transit Subtota	332	404	705	775	899	747	839	813	813	827	813
Auto Subtotal	25,095	25,023	34,794	34,724	34,600	34,752	34,660	34,686	34,686	34,672	34,686
Total	25,427	25,427	35,499	35,499	35,499	35,499	35,499	35,499	35,499	35,499	35,499

NOTE: Shaded areas indicate values adjusted from MTC orginal projections (see Table 2.3)

the ALRS. However, it was known that in Alternatives V-A and VI (the two alternatives with an internal SFIA BART station) some BART riders would have the option to walk to their destination. These adjustments are discussed in Section 2.3.

2.1.4 Peak Hour Vehicle Trip Table Development

As discussed below in Section 2.4., a traffic subarea model was created to assess the traffic impacts of the various project alternatives. This model is separate from the MTC model, however, the MTC model results were used as the basis for creating peak hour vehicle trip tables for use in the traffic model. This section discusses how the peak hour traffic trip tables were created.

Four basic data sets served as the initial inputs to create the peak hour vehicle trip tables for each alternative. These were:

1) MTC's 24-hour work and non-work person trip tables for auto-only (no transit component) trips.
2) MTC's 24-hour work and non-work person trip tables for rail transit trips using the auto access mode (i.e. MTC's estimate of the number of persons who would drive and park their cars at a BART or CalTrain station)
3) MTC-generated 24-hour "select link" vehicle volumes representing those automobiles with a trip end outside of the subarea model study area.
4) San Francisco International Airport air passenger projections for auto-only access to SFIA (as supplied by a subconsultant to MTC during the BART-San Francisco Airport Extension Alternatives Analysis/DEIS/DEIR, and as updated by MTC for this study).

Each of these basic data sets were factored and adjusted to arrive at the estimated a.m. and p.m. peak hour vehicle trip tables for 1993 and 2010 as required to operate the traffic model. The factoring process included the following key steps:

<u>Home-Based Work and Non-Work Auto Trip Adjustment Steps</u>

1) Factor 1990 MTC results to 1993 using a 3.2 percent growth factor (applies only for conversion of 1990 MTC runs to 1993). The total of 3.2 percent growth was actually arrived at by applying 17 percent of the total growth between 1990 and 2010 to each analysis zone (MTC's 700-zone system). The net result was an overall 3.2 percent increase in auto person trips. This method accounts for those zones where growth is projected to occur slower or faster than the average. Section 2.2.1 provides further discussion on the derivation of year 1993, 1998 and 2000 growth factors.

2) Remove MTC surrogate SFIA air passengers by removing 90 percent of non-work shopping trips to SFIA (see discussion under Section 2.1.3).
3) Add 9,800 additional daily work trips to SFIA to the trip table to account for SFIA Master Plan projections which indicate greater growth at SFIA than assumed in the MTC trip tables (applies only to 2010 MTC trip tables)
4) Disaggregate trip volume data from the 700-zone system used by MTC to the smaller zone system used within the traffic analysis subarea.
5) Remove all trips that have at least one trip end outside of the traffic subarea and replace these trips with the adjusted volumes from MTC select-link traffic volumes.
6) Convert MTC's 24-hour data to peak hour volumes using the peaking factors supplied by MTC as shown in Table 2.5.
7) Convert person trip data to vehicle trips using the auto occupancy factors supplied by MTC as shown in Table 2.6.

<u>Home-Based Work and Non-Work Transit Auto Access Trip Adjustment Steps</u>

1) Factor 1990 MTC results to 1993 using a 3.2 percent growth factor (applies only for conversion of 1990 MTC runs to 1993). Section 2.2.1 provides further discussion on the derivation of year 1993, 1998 and 2000 growth factors.
2) Remove MTC surrogate SFIA air passengers by removing 90 percent of non-work shopping trips to SFIA (see discussion under Section 2.1.3).
3) Disaggregate trip volume data from the 700-zone system used by MTC to the smaller zone system used within the traffic analysis subarea.
4) Convert MTC estimates for 24-hour BART and CalTrain auto access trips for work and non-work trips to the peak hour using factors shown in Table 2.5.

<u>SFIA Air Passenger Auto Trip Adjustment Steps</u>

1) Factor 1990 air passenger auto trip estimates to 1993 using a 3.2 percent growth factor (applies only for conversion of 1990 estimates to 1993). Section 2.1.3 provides further discussion on the derivation of year 1993, 1998 and 2000 growth factors.
2) Disaggregate trip volume data from the 700-zone system used by MTC to the smaller zone system used within the traffic analysis subarea.
3) Convert 24-hour data to peak hour volumes using the peaking factors supplied as shown in Table 2.5.
4) Convert person trip data to vehicle trips using the auto occupancy factors as shown in Table 2.6.

TABLE 2.5
PEAK HOUR FACTORS
FOR CONVERTING 24-HOUR VOLUMES TO THE PEAK HOUR

TRIP (1) PURPOSE	MODE	DIRECTION OF TRAVEL	AM PEAK FACTOR	PM PEAK FACTOR
HBW	Drive Alone	Home to Work	14.597 %	0.790 %
		Work to Home	0.514 %	12.661 %
	Shared Ride	Home to Work	17.763 %	0.857 %
		Work to Home	0.172 %	13.595 %
	Transit	All	21.000 %	21.000 %
NW	Auto	Home to Dest	4.476 %	3.528 %
		Dest to Home	1.576 %	6.155 %
	Transit	All	11.000 %	11.000 %
NHB	Auto	N/A	2.404 %	8.388 %
Air Pass (SFIA)	All	All	8.700 %	6.600 %

Source: Metropolitan Transportation Commission (MTC) and San Francisco International Airport, October, 1993

(1) Trip purposes are:
HBW = Home-Based Work
NW = Non-Work
NHB = Non-Home-Based

TABLE 2.6
AUTO OCCUPANCY FACTORS
FOR CONVERTING PERSON TRIPS TO VEHICLE TRIPS

TRIP PURPOSE	MODE	1990	2010
Home-Based Work	Drive Alone	1.00	1.00
	2-Person Carpool	2.00	2.00
	3+ Carpool	3.50	3.50
Home-Based Non-Work			
o Shopping		1.225	1.20
o Social/Rec		1.678	1.60
Non-Home-Based		1.231	1.20
Air Passengers		2.10	2.10

Source: Metropolitan Transportation Commission (MTC), October 1993

After the above adjustments were made, the data sets were combined into a total a.m. peak and a total p.m. peak vehicle trip table for 1993 and 2010 for each alternative. Because of the inconsistencies in some MTC model runs noted in Section 2.1.3, it was decided that the background traffic volumes (all vehicle trips except rail transit access auto trips) for the Proposed Project (LPA) should be used for all the build alternatives (Alternatives III, IV, V, V-A, V-B, and VI). This approach maintains consistency between alternatives for the traffic modeling results, and assures the results of the traffic analysis reflect changes caused by the alternative BART extension station locations rather than arbitrary differences between alternatives caused by the mode-choice model.

Finally, year 1998 and 2000 vehicle trip tables were interpolated by applying the growth rates established for those years (see Section 2.2.1).

2.2 INTERPOLATION OF ALTERNATIVES/SCENARIOS NOT MODELLED BY MTC

As shown on Table 2.2, MTC conducted model runs for every alternative for analysis year 2010, but not for each of the other three analysis years (1993, 1998, and 2000, with the year 2000 results only applicable to the air quality analysis). However, the alternatives that were modelled were specifically selected to provide a basis for interpolating travel projections for each alternative for each year that was not modelled. This section describes how this interpolation was accomplished.

2.2.1 Growth Rates for Intermediate Years

Three sources were reviewed to determine expected growth for each analysis year; MTC travel projections, Association of Bay Area Government (ABAG) demographic projections, and local study area traffic counts. As shown in Table 2.1, total growth in travel between 1990 and 2010 is projected by MTC to be 27.9 percent. ABAG demographic projections are broken down into 5-year increments as shown on Table 2.7 which displays both regional and San Mateo County projections for population and employment. Overall, ABAG is projecting a 24.7 percent growth in population and a 32.5 percent growth in employment between 1990 and 2010 for the region, and a 13.8 percent growth in population and a 23.3 percent growth in employment between 1990 and 2010 for San Mateo County.

The first step was to determine the growth rate between 1990 and 1993 (1993 being the base year for the analysis). This growth rate is required to convert 1990 MTC model runs to 1993, and to establish the base year values for estimating growth for 1998 and 2000. Based on the growth rate

TABLE 2.7
ABAG DEMOGRAPHIC PROJECTIONS

YEAR	REGIONAL POP	REGIONAL JOBS	SAN MATEO COUNTY POP	SAN MATEO COUNTY JOBS
PROJECTED POPULATION AND EMPLOYMENT				
1990	6,023,577	3,114,440	649,623	319,150
1993 (1)	N/A	N/A	664,843	331,808
1995	6,433,200	3,166,480	682,550	336,760
1998 (1)	N/A	N/A	703,370	360,518
2000	6,906,250	3,538,850	717,250	369,840
2005	7,233,750	3,898,340	732,100	387,080
2010	7,508,450	4,128,080	739,150	393,610
PERCENT GROWTH FROM PREVIOUS PERIOD				
1990	---	---	---	---
1993 (1)	N/A	N/A	2.3 %	4.0 %
1995	6.8 %	1.6 %	2.7 %	1.5 %
1998 (1)	N/A	N/A	3.1 %	7.1 %
2000	7.4 %	11.8 %	2.0 %	2.6 %
2005	4.7 %	10.2 %	2.1 %	4.7 %
2010	3.8 %	5.9 %	1.0 %	1.7 %
PERCENT GROWTH FROM 1990				
1990	---	---	---	---
1993 (1)	N/A	N/A	2.3 %	4.0 %
1995	6.8 %	1.6 %	5.1 %	5.5 %
1998 (1)	N/A	N/A	8.2 %	13.0 %
2000	14.7 %	13.6 %	10.4 %	15.9 %
2005	20.1 %	25.2 %	12.7 %	21.3 %
2010	24.7 %	32.5 %	13.8 %	23.3 %

Source: Projections '92 (Recession Update), Association of Bay Area Governments, July 1992; and Parsons Brinckerhoff Quade & Douglas, October 1993

(1) Interpolated estimates based on ABAG demographic projections, MTC travel forecasts, and 1990 and 1993 study area traffic counts. Interpolation of 1993 and 1998 regional population and employment was not required for the analysis methods used and is therefore not available.

projected by ABAG between 1990 and 1995 for both the region and San Mateo County, plus review of 1990 and 1993 traffic counts in San Mateo County, a growth rate of 3.2 percent was established for the period between 1990 and 1993. This value is essentially a straight line interpolation of ABAG growth rates between 1990 and 1995 and correlates reasonably well with available traffic counts. Table 2.7 displays the resulting 1993 population and employment projection for San Mateo County.

After the 1993 value was established, the next step was to estimate the growth rates to apply to the year 1998 and 2000 scenarios. The year 2000 growth rate was a simple calculation using ABAG's 2000 projections and the interpolated 1993 values. The result was that year 2000 travel projections for this study were assumed represent 70 percent of the total growth between 1993 and 2010. For 1998, the growth rate was estimated using straight line interpolation between the estimated 1993 values and ABAG's year 2000 projections. Using this method, it was estimated that 52 percent of the total growth between 1993 and 2010 would occur by 1998. That the five-year period between 1993 and 1998 represents 52 percent worth of total growth between 1993 and 2010 (a 17-year period) is a reflection of ABAG's projections which show most the growth occurring in the early years.

2.2.2 Estimating Scenarios Not Modelled by MTC

As shown in Table 2.2, MTC did not model every project alternative for the year 1990. In addition, no MTC model runs were conducted for 1998 and 2000. It was therefore necessary to estimate values for each of these scenarios, as well as convert all 1990 estimates to 1993.

Initially, the 1990 model runs that were conducted (i.e. the Proposed Project and Alternative I as shown on Table 2.2) were grown to 1993 using the 3.2 percent growth factor discussed above. The resulting volumes and mode-choice projections, which consisted of various kinds of transit projections (such as regional transit ridership, BART ridership, BART station activity, etc) as well as auto-only travel volumes, were then used to estimate 1993, 1998, and 2000 projections for each alternative.

Estimation of the 1998 and 2000 volumes for the Proposed Project and Alternative I involved a straightforward application of the 52 percent and 70 percent growth factors discussed above. For transit volumes, the 1998 growth factor was applied directly to each mode-choice output of the MTC model (year 2000 projections for transit volumes was not required for this project). For the vehicle trip tables used in the traffic subarea model, the two growth factors were applied to 1993 and 2010 traffic volume assignments to arrive at the intermediate years (i.e. separate traffic

assignments were not made for 1998 and 2000, rather the assignments for 1993 and 2010 were used and then the 52 percent and 70 percent growth factors were applied).

It should be noted that, because of the complexity of the regional transportation network and the ability of the MTC mode-choice model to account for localized growth (via the model's use of 700 distinct zones, each with an individual growth rate) that could exceed or be less than the regional average, using a single, study area-wide growth factor to arrive at 1993 values for some transit projections did not result in known 1993 results. For instance, applying a standard 3.2 percent growth factor to 1990 BART, CalTrain, SamTrans bus, and other similar MTC model projections for the No-Build Alternative (Alternative I) did not always result in 1993 estimates that matched actual 1993 ridership for those operators. Therefore, additional consideration was given to actual 1993 transit volumes where these were known to establish the basis for estimating 1998 values.

Once 1993 and 1998 transit volumes had been determined for the Proposed Project, it was possible to use this information as a basis for estimating transit volumes for the remaining alternatives (Alternatives II - VI). It was assumed that the relative difference between each of the "build" alternatives in 2010 (2010 results after adjustment as discussed in Section 2.1.3), including the Proposed Project, would remain the same for each of the years under study. Therefore, based on the values projected for the Proposed Project in 1993, 1998, and 2010, the 1993 and 1998 values for the other build alternatives were factored from the 2010 model run results to show the same growth percent (actually a decrease since the 1998 estimate was derived from the 2010 estimate) in each of the intermediate years. For the TSM Alternative, 1993 values were assumed to be proportional to 2010 estimates.

The process was slightly different for the vehicle trip tables created for the traffic modeling work described in Section 2.4. As discussed in Section 2.1.4, the background vehicle volumes (non-rail access auto trips) for all the build alternatives were assumed to be equivalent to those of the Proposed Project, so once the Proposed Project values had been determined, the remaining alternatives did not require further adjustment. Only the rail-access auto trips were factored as described above because these volumes were clearly different and distinct between the alternatives.

2.3 TRANSIT PROJECTIONS

A variety of transit projections were made by MTC for each project alternative as discussed in Sections 2.1.2 and 2.1.3. Among those presented in the Environmental Impact Report (EIR) and Environmental Impact Statement (EIS) for

this project that were available directly from the MTC mode-choice model are: regional transit ridership; BART, CalTrain, SamTrans, and Airport Light Rail System (ALRS) transit boardings and transfers; patronage for each BART extension station; and changes in transit ridership from key geographical areas such as downtown San Francisco and SFIA. In addition, several additional transit projections were derived from the MTC model results, including peak hour load factors on BART and CalTrain and changes to transit travel times between selected locations.

Section 2.2.2 elaborated on how alternatives for analysis years not modeled by MTC were estimated, and Section 2.1.3 discussed some basic adjustments to the MTC results that were required. This section discusses some additional refinements that were made to the MTC model results to account for some details that the model was not able to accurately estimate, and presents in summary fashion the final overall transit projections for each project alternative. Tables 2.8 through 2.13 show these summary transit patronage projections.

2.3.1 Refinements to MTC Model Results

The MTC model is a regional model covering the entire nine-county Bay Area. As such, the model is considered reliable for projections involving large geographical areas (e.g. total regional transit ridership), but does not always predict more localized effects with the same degree of accuracy.

The reasons for this are twofold. First, the size of the analysis zones used (in the MTC 700-zone system) are too great to capture accurate projections at a small scale. For instance, all of SFIA including large employment areas to the north of the terminals, are contained in one zone. This requires that the model assume every traveller to SFIA is going to the same location. The result was the MTC model assuming every BART rider to SFIA had to transfer to the Airport Light Rail System (ALRS). Second, there are thousands of connections between transit services included in the model network. This large number of connections, each of which requires input values for transfer times between services, results in some simplifications at the local level. The result is that the model may not have estimated transit behavior at the level of detail desired.

The study team, therefore, conducted some detailed analyses to arrive at more refined estimates for some projected transit volumes. These are described below.

<u>Walk Access To SFIA Terminals</u>

In Alternative V-A (Minimum Length Subway to Airport GTC) and Alternative VI (Millbrae Avenue via Airport

Table 2.8
Regional Transit Boardings (1)(2)
Daily Volume-Thousands (000)

YEAR	PROPOSED PROJECT	I NO BUILD	II TSM	III BASE	IV E-101	V MLBR INTMD	V-A GTC	V-B SAN BRUNO	VI MLBR AVE
1993 (3)	1,657	1,572	1,640	1,657	1,657	1,657	1,657	1,657	1,656
1998	1,902	1,876	1,882	1,902	1,902	1,902	1,902	1,902	1,901
2010	2,128	2,099	2,106	2,128	2,128	2,128	2,128	2,128	2,127
Change From No Build (ALT. I)									
1993 (3)	84.8	N/A	67.6	84.8	84.8	85.0	85.1	85.4	84.4
1998	26.0	N/A	6.3	26.1	26.0	26.2	26.4	26.7	25.6
2010	29.1	N/A	7.0	29.2	29.1	29.3	29.5	29.8	28.6

Source: MTC, BART-SFO AA/DEIS/DEIR Patronage Forecasts, May 1991
MTC, BART-SFO SDEIS/DEIR Patronage Forecasts, October 1993
Parsons Brinckerhoff, December 1993

1) The region is defined as the 9-county Bay Area region, including the counties of San Francisco, San Mateo, Santa Clara, Alameda, Contra Costa, Marin, Sonoma, Napa and Solano. Transit includes four major public operators - BART, CalTrain, SamTrans, Muni and private bus carriers to the Airport.

2) Boardings are the total number of partrons entering transit vehicles from all sources including transfers, auto and walk access.

3) 1993 No Build does not include BART to Colma. Analysis of 1993 Build Alternatives assumes the project is implemented in the baseline year (even though the actual opening year is 1998) and is provided as a means of measuring impacts due solely to the project without influences from general growth or other changes.

Table 2.9
Regional Daily Transit Operator Boardings (1)

YEAR	PROPOSED PROJECT	I NO BUILD	II TSM	III BASE	IV E-101	V MLBR INTMD	V-A GTC	V-B SAN BRUNO	VI MLBR AVE
1993 (2)									
BART	311,100	256,000	281,800	311,400	311,400	311,800	311,100	311,300	313,500
CALTRAIN	35,900	20,800	38,600	36,300	36,000	35,400	36,300	36,500	36,500
SAMTRANS	65,100	73,800	72,300	65,700	66,100	66,200	67,600	66,100	66,800
ALRS	11,900	N/A	3,900	11,900	12,100	11,900	10,500	11,700	4,000
Change From No Build (ALT. I)									
BART	55,100	N/A	25,800	55,400	55,400	55,800	55,100	55,300	57,500
CALTRAIN	15,100	N/A	17,800	15,500	15,200	14,600	15,500	15,700	15,700
SAMTRANS	(8,700)	N/A	(1,500)	(8,100)	(7,700)	(7,600)	(6,200)	(7,200)	(7,000)
ALRS	11,900	N/A	3,900	11,900	12,100	11,900	10,500	11,700	4,000
1998									
BART	357,100	321,300	323,400	357,400	357,400	357,800	357,000	357,200	359,700
CALTRAIN	41,200	29,600	44,300	41,700	41,300	40,600	41,700	41,900	41,900
SAMTRANS	74,700	81,300	83,000	75,400	75,900	76,000	77,600	79,800	76,700
ALRS	15,200	N/A	4,900	15,200	15,300	15,200	13,400	14,900	5,200
Change From No Build (ALT. I)									
BART	35,800	N/A	2,100	36,100	36,100	36,500	35,700	35,900	38,400
CALTRAIN	11,600	N/A	14,700	12,100	11,700	11,000	12,100	12,300	12,300
SAMTRANS	(6,600)	N/A	(1,700)	(5,900)	(5,400)	(5,300)	(3,700)	(5,500)	(4,600)
ALRS	15,200	N/A	4,900	15,200	15,300	15,200	13,400	14,900	5,200
2010									
BART	399,400	359,400	361,800	399,800	399,800	400,200	399,300	399,600	402,400
CALTRAIN	46,100	37,800	49,500	46,600	46,200	45,400	46,600	46,900	46,900
SAMTRANS	83,600	88,200	92,800	84,300	84,900	85,000	86,800	84,800	85,800
ALRS	18,800	N/A	6,100	18,800	19,000	18,800	16,600	18,500	6,400
Change From No Build (ALT. I)									
BART	40,000	N/A	2,400	40,400	40,400	40,800	39,900	40,200	43,000
CALTRAIN	8,300	N/A	11,700	8,800	8,400	7,600	8,800	9,100	9,100
SAMTRANS	(4,600)	N/A	4,600	(3,900)	(3,300)	(3,200)	(1,400)	(3,400)	(2,400)
ALRS	18,800	N/A	6,100	18,800	19,000	18,800	16,600	18,500	6,400
1998 Change from 1993 No Build (Alt. I)									
BART	101,100	N/A	67,400	101,400	101,400	101,800	101,000	101,200	103,700
CALTRAIN	20,400	N/A	23,500	20,900	20,500	19,800	20,900	21,100	21,100
SAMTRANS	900	N/A	9,200	1,600	2,100	2,200	3,800	6,000	2,900
ALRS	15,200	N/A	4,900	15,200	15,300	15,200	13,400	14,900	5,200
2010 Change from 1993 No Build (Alt I)									
BART	143,400	N/A	105,800	143,800	143,800	144,200	143,300	143,600	146,400
CALTRAIN	25,300	N/A	28,700	25,800	25,400	24,600	25,800	26,100	26,100
SAMTRANS	9,800	N/A	19,000	10,500	11,100	11,200	13,000	11,000	12,000
ALRS	18,800	N/A	6,100	18,800	19,000	18,800	16,600	18,500	6,400

Source: MTC, BART-SFO AA/DEIS/DEIR Patronage Forecasts, May 1991
MTC, BART-SFO DEIR/SDEIS Patronage Forecasts, October 1993
Parsons Brinckerhoff, December 1993

1) Boardings are the total number of partrons entering transit vehicles from all sources including transfers, auto and walk access.

2) 1993 No Build does not include BART to Colma. Analysis of 1993 Build Alternatives assumes the project is implemented in the baseline year (even though the actual opening year is 1998) and is provided as a means of measuring impacts due solely to the project without influences from general growth or other changes.

Table 2.10
Transit Utilization By Geographic Area (1)
Daily Person Trips

YEAR	PROPOSED PROJECT	I NO BUILD	II TSM	III BASE	IV E-101	V MLBR INTMD	V-A GTC	V-B SAN BRUNO	VI MLBR AVE
To SFIA									
1993 (2)	19,600	12,200	16,600	19,500	19,500	19,500	18,600	19,500	18,700
%	14.6%	9.1%	12.3%	14.5%	14.5%	14.5%	13.8%	14.5%	13.9%
1998	22,300	13,500	18,700	22,200	22,400	22,300	21,300	22,200	21,300
%	14.8%	8.9%	12.4%	14.7%	14.7%	14.8%	14.8%	14.1%	14.1%
2010	26,000	16,100	21,900	25,900	26,000	26,000	24,900	25,900	24,900
%	14.9%	9.2%	12.5%	14.8%	14.9%	14.9%	14.2%	14.2%	14.2%
To Northern San Mateo									
1993 (2)	11,900	9,200	10,500	12,100	12,300	12,300	12,100	12,100	12,400
%	9.1%	7.1%	8.1%	9.3%	9.5%	9.5%	9.3%	9.3%	9.5%
1998	12,400	9,700	11,200	12,700	12,900	12,900	12,700	12,600	13,100
%	9.0%	7.0%	8.1%	9.2%	9.3%	9.3%	9.2%	9.1%	9.5%
2010	13,300	10,300	11,900	13,600	13,800	10,900	13,600	13,500	14,000
%	9.1%	7.0%	8.1%	9.3%	9.4%	9.4%	9.3%	9.2%	9.5%
To Downtown San Francisco									
1993 (2)	46,300	40,400	43,000	45,900	47,300	47,600	47,400	47,100	47,300
%	39.9%	34.8%	37.0%	39.6%	40.8%	41.0%	40.9%	40.6%	40.7%
1998	49,300	42,900	45,500	48,700	50,300	50,600	50,400	50,100	50,300
%	40.0%	34.8%	36.9%	39.5%	40.8%	41.1%	40.9%	40.7%	40.8%
2010	52,300	45,600	48,400	51,700	53,300	53,600	53,400	53,100	53,300
%	40.0%	34.9%	37.0%	39.6%	40.8%	41.0%	40.9%	40.6%	40.7%

Source: MTC, BART-SFO AA/DEIS/DEIR Patronage Forecasts, May 1991
MTC, BART-SFO DEIR/SDEIS Patronage Forecasts, October 1993
Parsons Brinckerhoff, December 1993

1) Transit utilization is an indicator of how many people making a trip would choose transit over another mode (e.g., bicycle, automobile, walk).

2) Analysis of 1993 Build Alternatives assumes the project is implemented in the baseline year (even though the actual opening year is 1998) and is provided as a means of measuring impacts due solely to the project without influences from general growth or other changes.

Table 2.11
Daily Intermodal Transfers
Between Rail Services

YEAR	PROPOSED PROJECT	I NO BUILD	II TSM	III BASE	IV E-101	V MLBR INTMD	V-A GTC	V-B SAN BRUNO	VI MLBR AVE
1993 (1)									
BART-CALTRAIN	16,300	N/A	N/A	16,700	16,500	16,300	16,800	16,700	19,900
BART - ALRS	8,400	N/A	N/A	8,400	8,600	8,400	7,400	8,500	5,100
CALTRAIN - ALRS (2)	3,500	N/A	3,400	3,500	3,500	3,200	3,300	3,300	*
1998									
BART - CALTRAIN	17,700	N/A	N/A	18,200	18,000	17,700	18,200	18,200	21,700
BART - ALRS	10,700	N/A	N/A	10,700	10,900	10,700	9,400	10,800	6,500
CALTRAIN - ALRS (2)	4,400	N/A	4,400	4,400	4,400	4,400	4,200	4,200	*
2010									
BART - CALTRAIN	19,100	N/A	N/A	19,500	19,300	19,600	19,600	19,500	23,300
BART - ALRS	13,300	N/A	N/A	13,300	13,500	13,000	11,700	13,400	8,000
CALTRAIN - ALRS (2)	5,500	N/A	5,400	5,500	5,500	5,100	5,400	5,400	*

Source: MTC, BART-SFO AA/DEIS/DEIR Patronage Forecasts, May 1991
MTC, BART-SFO DEIR/SDEIS Patronage Forecasts, October 1993
Parsons Brinckerhoff, December 1993

1) Analysis of Build 1993 Alternatives assumes the project is implemented in the baseline year (even though the actual opening year is 1998) and is provided as a means of measuring impacts due solely to the project without influences from general growth or other changes.
2) Transfers for Intermodal Stations only (CalTrain/BART/ALRS stations).

*CALTRAIN - ALRS requires a double transfer via BART and trips are included in the BART-ALRS transfers.

Table 2.12
Daily Trips By Mode to SFIA (1)

YEAR	PROPOSED PROJECT	I NO BUILD	II TSM	III BASE	IV E-101	V MLBR INTMD	V-A GTC	V-B SAN BRUNO	VI MLBR AVE
1993 (2)									
BART	8,500	N/A	N/A	8,500	8,600	8,500	8,600	8,500	8,500
CALTRAIN	3,600	400	3,700	3,600	3,600	3,600	3,500	3,500	3,500
BUS (3)	10,300	15,000	15,500	10,200	10,300	10,200	10,300	10,400	10,200
AUTO (4)	131,300	138,200	134,400	131,300	131,300	131,300	131,300	131,300	131,400
TOTAL	153,700	153,600	153,600	153,600	153,800	153,600	153,700	153,700	153,600
1998									
BART	10,700	N/A	N/A	10,700	10,800	10,700	10,800	10,700	10,800
CALTRAIN	4,500	600	4,600	4,500	4,500	4,500	4,400	4,400	4,400
BUS (3)	12,100	18,200	18,900	12,000	12,100	12,000	12,100	12,200	12,100
AUTO (4)	163,900	172,300	167,600	164,000	163,800	164,000	163,900	163,900	164,000
TOTAL	191,200	191,100	191,100	191,200	191,200	191,200	191,200	191,200	191,300
2010									
BART	13,200	N/A	N/A	13,200	13,400	13,200	13,300	13,200	13,300
CALTRAIN	5,500	700	5,700	5,500	5,500	5,500	5,400	5,400	5,400
BUS (3)	15,000	22,600	23,300	14,900	15,000	14,900	15,000	15,100	14,900
AUTO (4)	203,000	213,400	207,700	203,100	202,800	203,100	203,000	203,000	203,100
TOTAL	236,700	236,700	236,700	236,700	236,700	236,700	236,700	236,700	236,700

Source: Parsons Brinckerhoff and Korve Engineering, May 1994, estimated using data from MTC, BART-SFO AA/DEIS/DEIR Patronage Forecasts, May 1991; MTC, BART-SFO DEIR/SDEIS Patronage Forecasts, October 1993; and Deakin,Harvey,Skabardonis, "Forecasting Air Passenger Demand for a BART Extension to SFIA,"March 1992

1) Daily trips include people traveling to or from SFIA.
2) Analysis of Build 1993 Alternatives assumes the project is implemented in the baseline year (even though the actual opening year is 1998) and is provided as a means of measuring impacts due solely to the project without influences from general growth or other changes.
3) Bus includes shuttle buses as well as buses operated by SamTrans and Muni.
4) Auto includes taxis as well as private passenger motor vehicles.

Table 2.13
BART Daily Patronage By Station (1)

STATION	PROPOSED PROJECT	I NO BUILD	II TSM	III BASE	IV E-101	V MLBR INTMD	V-A GTC	V-B SAN BRUNO	VI MLBR AVE
1993 (2)									
DALY CITY	12,100	12,500	11,200	12,000	11,900	11,900	11,900	11,900	11,900
COLMA	14,100	-	28,100	14,500	14,700	14,600	14,300	14,300	14,200
SUBTOTAL	26,200	12,500	39,300	26,500	26,600	26,500	26,200	26,200	26,100
HICKEY/CHESTNUT (3)	6,600	-	-	5,600	7,500	7,500	7,000	7,000	5,600
TANFORAN/SAN BRUNO (4)	10,500	-	-	9,400	27,300	9,700	33,300	42,500	7,600
AIRPORT (INTERNAL) (5)	-	-	-	-	10,400	-	9,300	-	12,000
AIRPORT INTERMODAL	32,200	-	-	34,300	-	-	-	-	-
MILLBRAE INTERMODAL (6)	-	-	-	-	5,600	35,000	-	-	29,400
SUBTOTAL	49,300	0	0	49,300	50,800	52,200	49,600	49,500	54,600
TOTAL	75,500	12,500	39,300	75,800	77,400	78,700	75,800	75,700	80,700
1998									
DALY CITY	12,800	12,800	11,800	12,700	12,600	12,600	12,600	12,600	12,600
COLMA	14,800	32,700	30,100	15,300	15,400	15,400	15,100	15,100	15,000
SUBTOTAL	27,600	45,500	41,900	28,000	28,000	28,000	27,700	27,700	27,600
HICKEY/CHESTNUT (3)	7,000	-	-	5,900	8,000	8,000	7,400	7,400	5,900
TANFORAN/SAN BRUNO (4)	11,300	-	-	10,100	29,000	10,400	35,400	45,800	8,200
AIRPORT (INTERNAL) (5)	-	-	-	-	11,800	-	10,600	-	15,200
AIRPORT INTERMODAL	34,800	-	-	37,000	-	-	-	-	-
MILLBRAE INTERMODAL (6)	-	-	-		6,000	37,700	-	-	31,400
SUBTOTAL	53,100	0	0	53,000	54,800	56,100	53,400	53,200	60,700
TOTAL	80,700	45,500	41,900	81,000	82,800	84,100	81,100	80,900	88,300
2010									
DALY CITY	13,500	13,600	12,400	13,400	13,300	13,300	13,300	13,300	13,300
COLMA	15,600	35,200	32,400	16,100	16,200	16,100	15,800	15,600	15,700
SUBTOTAL	29,100	48,800	44,800	29,500	29,500	29,400	29,100	28,900	29,000
HICKEY/CHESTNUT (3)	7,400	-	-	6,300	8,400	8,400	7,800	7,800	6,300
TANFORAN/SAN BRUNO (4)	12,200	-	-	10,800	30,800	11,200	37,600	49,800	8,800
AIRPORT (INTERNAL) (5)	-	-	-	-	13,700	-	12,400	-	18,700
AIRPORT INTERMODAL	38,000	-	-	40,300	-	-	-	-	-
MILLBRAE INTERMODAL (6)	-	-	-	-	6,300	41,100	-	-	33,600
SUBTOTAL	57,600	0	0	57,400	59,200	60,700	57,800	57,600	67,400
TOTAL	86,700	48,800	44,800	86,900	88,700	90,100	86,900	86,500	96,400

Source: MTC, BART-SFO AA/DEIS/DEIR Patronage Forecasts, May 1991; MTC, BART-SFO DEIR/SDEIS Patronage Forecasts, October 1993; and Parsons Brinckerhoff, Subarea Travel Model, December 1993

1) Patronage is defined as the number of entrances and exits at a particular station.
2) Analysis of 1993 Build Alternatives assumes the project is implemented in the baseline year (even though the actual opening year is 1998) and is provided as a means of measuring impacts due solely to the project without influences from general growth or other changes.
3) The Base Case Alternative includes the Chestnut Station, whereas the other build alternatives include the Hickey Station.
4) Alternative IV includes two options for a station location in San Bruno: Tanforan or I-380. Alternative V includes three options for a San Bruno station: Tanforan, I-380 or Downtown San Bruno. Design Options V-A and V-B include two options in San Bruno: I-380 or Downtown San Bruno. The proposed project, Alternatives III and VI include a station at Tanforan.
5) Alternative IV includes a station at a long-term parking lot to SFIA. Design Option V-A includes two option station locations at SFIA: GTC Subway Structure or GTC Aerial Structure. Alternative VI includes a station at the International Terminal of SFIA.
6) Alternative IV and Alternative V include an intermodal station in Millbrae at Center Street. Alternative VI includes a Millbrae Avenue Station with a BART/CalTrain connection.

International Terminal), BART stations are located within walking distance of the SFIA passenger terminals. Also, in Alternative IV, (Airport Aerial East of Highway 101), a BART station is located at the airport long-term parking lot which is within walking distance of some employment areas. In order to estimate the number of BART riders who would walk to their final destination, an analysis was conducted which evaluated the placement and amount of employment within SFIA property, the volumes of air passengers using various terminals, and the walk distances related to each of these locations assuming SFIA proceeds with construction of its Ground Transportation Center and new International Terminal.

The estimates from this analysis are shown in Table 2.14. The resulting numbers of walk access trips at SFIA were removed from the transfer (to the ALRS) mode at the indicated station and added to the walk mode as shown in the BART station patronage tables included in the EIR/EIS for this project. This analysis was not used to change overall transit ridership to the airport.

TABLE 2.14
PERCENT OF SFIA EMPLOYEES AND AIR PASSENGERS WITHIN WALKING DISTANCE OF THEIR FINAL DESTINATION

ALTERNATIVE	BART STATION	EMPLOYEES	AIR PASSENGERS
IV	SFIA Long-Term Parking Station	2 percent of employees working in remote areas	None
V-A	Airport GTC Station	20 percent of employees working in terminal area (100 percent of employees working at the GTC or International Terminal	1.6 percent of air passengers (10 percent of air passengers destined for the International Terminal
VI	International Terminal Station	90 percent of employees working in terminal area	75 percent of air passengers

Source: BART, May 5, 1994

Travel Time For Connections to SFIA

A detailed analysis was conducted to more precisely determine the BART and CalTrain patron travel times involved for connections to the airport terminals and employment areas for air passengers, workers, and other airport-bound travelers. This was done because the MTC model provides a fairly simplistic simulation of the rather complicated series of movements possible near the airport (which vary considerable depending on the alternative and which final destination is selected). Possible travel routes for transit patrons who walk or, alternatively, transfer to the ALRS from either BART or CalTrain include horizontal and vertical movements involving moving walkways, stairs, escalators, elevators, double transfers, and other features.

The results of this analysis were adjustments to rail ridership to SFIA and rail-to-rail transfer volumes (between BART, CalTrain, and the ALRS). The effect of these adjustments was to improve the degree of accuracy related to the relative volumes of patrons for each alternative who would use each mode. The estimated volumes from this analysis appear in Tables 2.11 and 2.12, and are reflected in the more detailed tables included in the EIS/EIR as well.

2.3.2 Derivations From MTC Model Results

Some transit ridership projections shown in the EIR/EIS consist of values that were not available as direct outputs of the MTC model. These include daily trips by mode to SFIA and transit travel times between selected origins and destinations. This section discussed how these values were estimated.

Daily trips by mode to SFIA (see Table 2.12) was not produced directly by the MTC model. The model did provide total regional volumes for each mode, which includes BART, CalTrain, bus, and automobile, and also provides a breakdown between transit and auto for trips to SFIA, but data for the subset of travellers specifically going to SFIA was not available for each of the transit modes. Using the total transit volumes to SFIA, the study team estimated the proportion applicable to each of the three transit modes through review of airport station passenger entries and exits for BART and CalTrain, and review of individual "link" volumes for locations near the airport. (Links are sections of the MTC model network which represent paths of movement.) Based on this data, it was possible to derive reasonable estimates as to the number of airport workers and air passengers who would use BART, CalTrain, or a bus for their trip.

Travel time estimates between selected origins and destinations were developed to assess the effect of the BART

extension on travel times. The MTC model does provide some travel time results, however, this data includes some portions of travel (such as a the home to rail station travel times) which tend to dilute the effect of the BART extension itself and, as discussed in Section 2.3.1, the model contains some simplifications at the local level which could slightly misstate the actual travel time changes. For these reasons, the travel time methodology used in the BART-San Francisco Airport Extension Alternatives Analysis/DEIS/DEIR was adopted for this study.

The method adopted involved the manual tracing of a trip through each of the modes (including initial wait time, walk time, transfer time, and in-vehicle time for BART, CalTrain, buses, and other transit modes) required for travel between the selected origins and destinations. Each traveler was assumed to start their trip at a "screenline." The screenline was a location near a rail station that allowed access to all the available modes serving the origins and destinations under evaluation. The effect of using the screenline concept was to eliminate the arbitrary assumption used in the MTC model (arbitrary in the sense that all trips from any given zone are assumed to start at a zone centroid) regarding the time necessary to reach a rail station.

Starting at the screenline, each of the possible transit "paths" (paths consist of the modes and movements necessary to travel between any two given points) were traced to identify the fastest path between the select origin and each destination. This value for the fastest transit path was then reported in the EIS/EIR produced for this project.

2.4. TRAFFIC PROJECTIONS

2.4.1. Traffic Data Collection

Traffic counts were collected for 61 study area intersections and key sections of the Highway 101 freeway. These traffic counts were used to establish existing (September, 1993) conditions, to develop growth factors for adjusting MTC model runs from 1990 to 1993, to validate the sub-area traffic model network, to establish a baseline for use in adjustment of the projected intersection turning movements, and to establish the saturation flow rates needed for the intersection capacity analysis.

Other field count data was also collected by the project team, and traffic count data was obtained from local cities, Caltrans and the San Mateo County Congestion Management Agency. This information was used for sub-area traffic model validation and the development of growth factors.

Intersection Selection Process

Sixty-one existing intersections were selected for analysis based on a number of criteria. All intersections mentioned in comments received during public review of the BART-SFO Extension AA/DEIS/DEIR study completed in March 1992 were included, and the study team used professional judgement to select additional intersections that could potentially be impacted by one or more BART extension alternatives. Overall, the following considerations were used to select the 61 intersections:

- All nineteen intersections evaluated in the AA/DEIS were retained.

- Additional intersections identified by local jurisdictions and Caltrans are included, with the exception of intersections determined to be clearly not impacted by any of the BART station alternatives.

- In some cases, local jurisdictions requested evaluation of particular areas (primarily neighborhoods) without identifying specific intersections. The project team used professional judgement in determining which additional intersections should be included to determine effects for these areas.
- The project team critically reviewed the list of intersections for potential adverse impacts and selected a small number of additional intersections not identified from the above sources.

Table 2.15 lists the 61 existing intersections. The table also lists 31 "Future" intersections (intersections created as part of the BART extension project) associated with BART station alternatives for a total of 92 intersections for analysis. Exhibit 2.1 provides a location map for the 92 intersections.

The Town of Colma requested that six intersections near the Colma BART Station be evaluated in this study. These intersections were not included in this analysis because they were previously evaluated in the Colma BART Station AA/DEIS/DEIR and FEIS, and because there would be no adverse impacts on these intersections as a result of extending BART to the San Francisco Airport. Rather, the extension of BART would draw traffic away from the Colma BART Station, and thus reduce traffic traveling through the Town of Colma resulting in beneficial impacts at these locations.

All 92 intersections were reviewed by the air quality analysis team. Using criteria they determined appropriate, air quality analysis was conducted on a subset of 26 intersections.

TABLE 2.15

BART/SFO INTERSECTIONS

BART/SFO AIRPORT EXTENSION DEIR/SDEIS

LEGEND : - = Not Applicable S = Signal U = Unsignalized (side street stop sign) AWS = All Way Stop KNR = Kiss-n-Ride PNR = Park-n-Ride

NORTH/SOUTH STREET	EAST/WEST STREET	INTER-SEC-TION NO.	EXISTING OR FUTURE ?	AIR QUAL. YEAR 2000	ALTERNATIVES							
					LPA Locally Prefer'd Alt. *LPA*	Alt. I No Build *NBLD*	Alt. II TSM *TSM*	Alt. III Base Case *BASEC*	Alt. IV East Side Exten. *EASTS*	Alt. V Min. Length Subway *MINSUB*	Alt.Va/Vb GTC & Stage 1 *STG1*	Alt. VI Millbrae Ave. Station *ALT 6*
EL CAMINO REAL	HICKEY BLVD.	3	EXIST	Y	S	S	S	S	S	S	S	S
EL CAMINO REAL	HICKEY BLVD. EXTENSION	4	FUT		S	-	S	S	S	S	S	S
HICKEY BART STATION EXIT	HICKEY BLVD. EXTENSION	5	FUT		U	-	-	-	U	U	U	U
MISSION ROAD	HICKEY BLVD. EXTENSION	6	FUT		S	-	S	S	S	S	S	S
MISSION ROAD	HICKEY BART KNR ENTR.	7	FUT		U	-	-	-	U	U	U	U
MISSION ROAD	EVERGREEN DRIVE	8	EXIST	Y	AWS	AWS	AWS	AWS	AWS	AWS	AWS	AWS
MISSION ROAD	HICKEY BART KNR EXIT	9	FUT		U	-	-	-	U	U	U	U
HICKEY BART PNR ENTR/EXI	NEW STREET	10	FUT		U	-	-	-	U	U	U	U
MISSION ROAD	NEW STREET	11	FUT	Y	AWS	-	-	-	AWS	AWS	AWS	AWS
HICKEY BART BUS/KNR ENTR	NEW STREET	12	FUT		U	-	-	-	U	U	U	U
EL CAMINO REAL	NEW STREET	13	FUT	Y	S	-	-	-	S	S	S	S
MISSION ROAD	GRAND AVE.	14	EXIST	Y	AWS	AWS	AWS	AWS	AWS	AWS	AWS	AWS
ALDENGLEN DR./OAK AVE.	GRAND AVE.	15	EXIST		U	U	U	U	U	U	U	U
CHESTNUT AVE.	GRAND AVE.	16	EXIST	Y	S	S	S	S	S	S	S	S
MISSION ROAD	CHESTNUT BART ENTR.	17	FUT		-	-	-	U	-	-	-	-
MISSION ROAD	CHESTNUT BART EXIT	18	FUT		-	-	-	U	-	-	-	-
MISSION ROAD	OAK AVE.	19	EXIST	Y	U	U	U	S	U	U	U	U
BART BUS ENTRANCE/EXIT	ARROYO/OAK EXTENSION	20	FUT		-	-	-	U	-	-	-	-
EL CAMINO REAL	ARROYO DR.	21	EXIST	Y	S	S	S	S	S	S	S	S

TABLE 2.15
BART/SFO INTERSECTIONS
BART/SFO AIRPORT EXTENSION DEIR/SDEIS

LEGEND = Not Applicable S = Signal U = Unsignalized (side street stop sign) AWS = All Way Stop KNR = Kiss-n-Ride PNR = Park-n-Ride

NORTH/SOUTH STREET	EAST/WEST STREET	INTER-SEC-TION NO.	EXISTING OR FUTURE ?	AIR QUAL. YEAR 2000	ALTERNATIVES							
					LPA Locally Prefer'd Alt.	Alt. I No Build	Alt. II TSM	Alt. III Base Case	Alt. IV East Side Exten.	Alt. V Min. Length Subway	Alt.Va/Vb GTC & Stage 1	Alt. VI Millbrae Ave. Station
					LPA	*NBLD*	*TSM*	*BASEC*	*EASTS*	*MINSUB*	*STG1*	*ALT 6*
CAMARITAS AVE.	ARROYO DR.	22	EXIST		AWS	AWS	AWS	AWS	AWS	AWS	AWS	AWS
JUNIPERO SERRA BLVD.	WESTBOROUGH BLVD.	23	EXIST	Y	S	S	S	S	S	S	S	S
CAMARITAS AVE.	WESTBOROUGH BLVD.	24	EXIST		S	S	S	S	S	S	S	S
EL CAMINO REAL	WESTBOROUGH BLVD.	25	EXIST	Y	S	S	S	S	S	S	S	S
ANTONETTE LANE	CHESTNUT AVE.	26	EXIST		S	S	S	S	S	S	S	S
MISSION ROAD	CHESTNUT AVE.	27	EXIST		S	S	S	S	S	S	S	S
EL CAMINO REAL	WEST ORANGE AVE.	28	EXIST		S	S	S	S	S	S	S	S
EL CAMINO REAL	SOUTH SPRUCE AVE.	29	EXIST	Y	S	S	S	S	S	S	S	S
HUNTINGTON AVE.	SOUTH SPRUCE AVE.	30	EXIST		S	S	S	S	S	S	S	S
EL CAMINO REAL	NOOR AVE.	31	EXIST		U	U	U	U	U	U	U	U
HUNTINGTON AVE.	NOOR AVE.	32	EXIST		S	S	S	S	S	S	S	S
NORTHBOUND I-280	SNEATH LANE	33	EXIST		S	S	S	S	S	S	S	S
EL CAMINO REAL	SNEATH LANE	34	EXIST	Y	S	S	S	S	S	S	S	S
HUNTINGTON AVE.	TANFORAN BART EXIT	35	FUT		U	-	-	U	-	-	-	-
HUNTINGTON AVE.	SNEATH LN./BART PNR	36	EXIST	Y	S	AWS	AWS	S	AWS	AWS	AWS	S
HUNTINGTON AVE.	TANFORAN BART ENTR.	37	FUT		U	-	-	U	-	-	-	-
DOLLAR AVE./HERMAN ST.	TANFORAN AVE.	38	EXIST		U	U	U	U	U	U	U	U
EL CAMINO REAL	WESTBOUND I-380 OFF	40	EXIST		S	S	S	S	S	S	S	S
EL CAMINO REAL	EASTBOUND I-380 OFF	41	EXIST		S	S	S	S	S	S	S	S

TABLE 2.15

BART/SFO INTERSECTIONS

BART/SFO AIRPORT EXTENSION DEIR/SDEIS

LEGEND : = Not Applicable S = Signal U = Unsignalized (side street stop sign) AWS = All Way Stop KNR = Kiss-n-Ride PNR = Park-n-Ride

NORTH/SOUTH STREET	EAST/WEST STREET	INTER-SEC-TION NO.	EXISTING OR FUTURE ?	AIR QUAL. YEAR 2000	ALTERNATIVES							
					LPA	Alt. I	Alt. II	Alt. III	Alt. IV	Alt. V	Alt.Va/Vb	Alt. VI
					Locally Prefer'd Alt.	No Build	TSM	Base Case	East Side Exten.	Min. Length Subway	GTC & Stage 1	Millbrae Ave. Station
					LPA	*NBLD*	*TSM*	*BASEC*	*EASTS*	*MINSUB*	*STG1*	*ALT 6*
HERMAN ST.	SCOTT ST.	42	EXIST		AWS	AWS	AWS	AWS	AWS	AWS	AWS	AWS
HUNTINGTON AVE.	FOREST LANE	43	EXIST		AWS	AWS	AWS	AWS	AWS	AWS	AWS	AWS
NORTHBOUND I-280 RAMPS	SAN BRUNO AVE.	44	EXIST		S	S	S	S	S	S	S	S
EL CAMINO REAL	SAN BRUNO AVE.	45	EXIST	Y	S	S	S	S	S	S	S	S
HUNTINGTON AVE.	SAN BRUNO AVE.	47	EXIST		S	S	S	S	S	S	S	S
SAN MATEO AVE.	SAN BRUNO AVE.	48	EXIST	Y	S	S	S	S	S	S	S	S
SECOND AVE.	SAN BRUNO AVE.	49	EXIST	Y	U	U	U	U	S	U	S	U
THIRD AVE.	SAN BRUNO AVE.	50	EXIST		S	S	S	S	S	S	S	S
SAN MATEO AVE.	I-380/San Bruno BART PNR	53	FUT		-	-	-	-	U	U	U	-
SOUTH AIRPORT BLVD.	I-380 ON RAMP	54	EXIST		S	S	S	S	S	S	S	S
SOUTH AIRPORT BLVD.	I-380 OFF RAMP	55	EXIST		S	S	S	S	S	S	S	S
SOUTH AIRPORT BLVD.	SAN BRUNO AVE. EXT'N	56	EXIST		S	S	S	S	S	S	S	S
MCDONNALL ROAD	Airp. L. Term Park BART ENTR	57	FUT		-	-	-	-	U	-	-	-
MCDONNALL ROAD	Airp. L. Term Park BART EXIT	58	FUT		-	-	-	-	S	-	-	-
SAN MATEO AVE.	FIRST AVE.	59	EXIST		U	U	U	U	U	U	U	U
SAN MATEO AVE.	HUNTINGTON AVE.	60	EXIST	Y	U	U	U	U	U	U	U	U
SAN MATEO AVE.	ANGUS AVE.	61	EXIST		AWS	AWS	AWS	AWS	AWS	AWS	AWS	AWS
HUNTINGTON AVE.	ANGUS AVE.	62	EXIST	Y	AWS	AWS	AWS	AWS	AWS	AWS	AWS	AWS
FIRST AVE.	ANGUS AVE.	63	EXIST		U	U	U	U	U	U	U	U

TABLE 2.15

BART/SFO INTERSECTIONS

BART/SFO AIRPORT EXTENSION DEIR/SDEIS

LEGEND - = Not Applicable S = Signal U = Unsignalized (side street stop sign) AWS = All Way Stop KNR = Kiss-n-Ride PNR = Park-n-Ride

NORTH/SOUTH STREET	EAST/WEST STREET	INTER-SEC-TION NO.	EXISTING OR FUTURE ?	AIR QUAL. YEAR 2000	ALTERNATIVES							
					LPA Locally Prefer'd Alt.	Alt. I No Build	Alt. II TSM	Alt. III Base Case	Alt. IV East Side Exten.	Alt. V Min. Length Subway	Alt.Va/Vb GTC & Stage 1	Alt. VI Millbrae Ave. Station
					LPA	*NBLD*	*TSM*	*BASEC*	*EASTS*	*MINSUB*	*STG1*	*ALT 6*
EL CAMINO REAL	JENEVEIN AVE.	64	EXIST		S	S	S	S	S	S	S	S
EL CAMINO REAL	SAN FELIPE AVE.	65	EXIST		S	S	S	S	S	S	S	S
HUNTINGTON AVE.	SAN FELIPE AVE.	66	EXIST		U	U	U	U	U	U	U	U
EL CAMINO REAL	SANTA INEZ AVE.	67	EXIST		S	S	S	S	S	S	S	S
SAN ANTONIO AVE.	SANTA INEZ AVE.	68	EXIST		U	U	U	U	U	U	U	U
EL CAMINO REAL	CENTER STREET	69	EXIST	Y	S	S	S	S	S	S	S	S
SAN ANSELMO AVE.	CENTER STREET	70	EXIST		U	U	U	U	U	U	U	U
MADRONE/MONTEREY ST.	CENTER STREET	71	EXIST		U	U	U	U	-	-	U	U
EL CAMINO REAL	MILLBRAE AVE.	72	EXIST	Y	S	S	S	S	S	S	S	S
ROLLINS RD.	MILLBRAE AVE.	80	EXIST	Y	-	S	S	-	-	-	-	S
SOUTHBOUND I-280 RAMPS	SNEATH LANE	81	EXIST	Y	S	S	S	S	S	S	S	S
SOUTHBOUND I-280 RAMPS	SAN BRUNO AVE.	82	EXIST		S	S	S	S	S	S	S	S
SAN MATEO AVE.	I-380/S. Bruno BART KNR ENT	106	FUT		-	-	-	-	U	U	U	-
SAN MATEO AVE.	I-380/S. Bruno BART KNR EXIT	107	FUT		-	-	-	-	U	U	U	-
BAY STREET	CENTER STREET	108	FUT		-	-	-	-	S	S	-	-
Airport Intermodal NEW ROAD	NB 101 OFF-RAMP	109	FUT		AWS	-	-	AWS	-	-	-	-
Airport Intermodal NEW ROAD	SB 101 RAMPS	110	FUT		AWS	-	-	AWS	-	-	-	-
Airport Intermodal NEW ROAD	Airport Intermodal EXIT	111	FUT		U	-	-	U	-	-	-	-
Airport Intermodal NEW ROAD	Airport Intermodal ENTR./EXIT	112	FUT		AWS	-	-	AWS	-	-	-	-

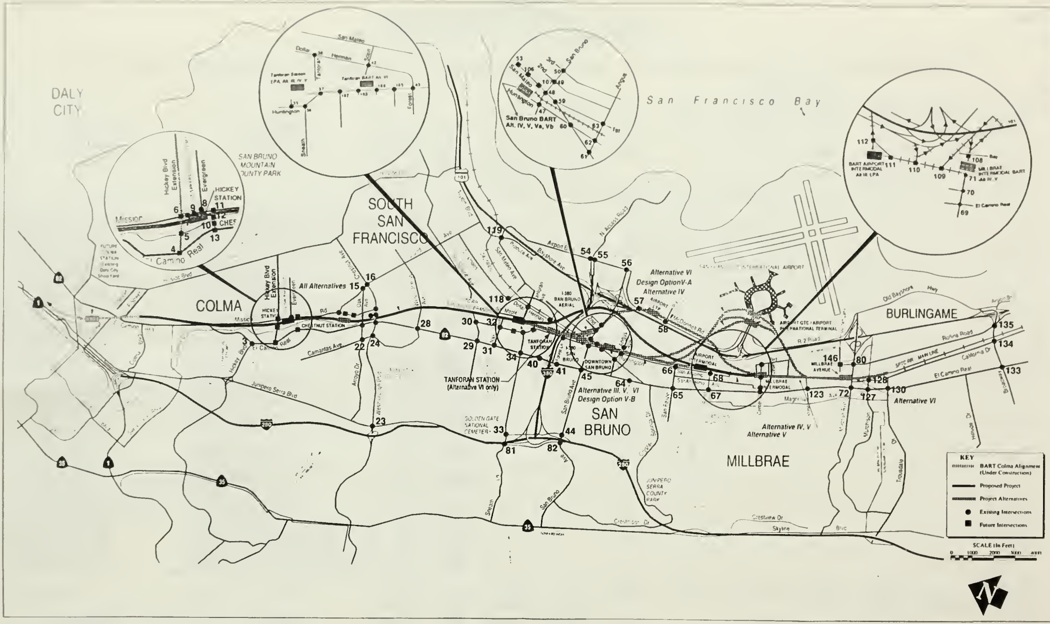
TABLE 2.15

BART/SFO INTERSECTIONS

BART/SFO AIRPORT EXTENSION DEIR/SDEIS

LEGEND : - = Not Applicable S = Signal U = Unsignalized (side street stop sign) AWS = All Way Stop KNR = Kiss-n-Ride PNR = Park-n-Ride

NORTH/SOUTH STREET	EAST/WEST STREET	INTER-SEC-TION NO.	EXISTING OR FUTURE ?	AIR QUAL. YEAR 2000	ALTERNATIVES							
					LPA	Alt. I	Alt. II	Alt. III	Alt. IV	Alt. V	Alt.Va/Vb	Alt. VI
					Locally Prefer'd Alt.	No Build	TSM	Base Case	East Side Exten.	Min. Length Subway	GTC & Stage 1	Millbrae Ave. Station
					LPA	*NBLD*	*TSM*	*BASEC*	*EASTS*	*MINSUB*	*STG1*	*ALT 6*
SAN MATEO AVE.	PRODUCE/AIRPORT BLVD.	119	EXIST		-	S	S	-	-	-	-	S
EL CAMINO REAL	EAST HILLCREST BLVD.	123	EXIST		-	S	S	-	-	-	-	S
EL CAMINO REAL	MURCHISON DR.	127	EXIST	Y	-	S	S	-	-	-	-	S
CALIFORNIA DR.	MURCHISON DR.	128	EXIST		-	U	U	-	-	-	-	U
EL CAMINO REAL	TROUSDALE DR.	130	EXIST		-	S	S	-	-	-	-	S
EL CAMINO REAL	BROADWAY	133	EXIST		-	S	S	-	-	-	-	S
CALIFORNIA DR.	BROADWAY	134	EXIST	Y	-	S	S	-	-	-	-	S
ROLLINS RD.	BROADWAY	135	EXIST		-	S	S	-	-	-	-	S
ROLLINS RD.	BART ENTR./GARDEN LN.	146	FUT		-	-	-	-	-	-	-	S
HUNTINGTON	TANFORAN DRIVEWAY NORT	162	EXIST		-	-	-	-	-	-	-	U
HUNTINGTON	BART ENTRANCE	163	FUT		-	-	-	-	-	-	-	S
HUNTINGTON	BART EXIT	164	FUT		-	-	-	-	-	-	-	S
HUNTINGTON	TANFORAN DRIVEWAY SOUT	165	EXIST		-	-	-	-	-	-	-	U



OGDEN PB 100 YEARS

Intersections Potentially Affected by BART-San Francisco Airport Extension

Exhibit 2.1

Intersection Counts

The initial set of counts conducted in September, 1993 were designed to provide traffic data for the freeways and the BART station impact areas for eight alternatives: the LPA, No Build, TSM, and Alternatives III, IV, V, V-A, and V-B. In March, 1994, a ninth alternative, Alternative VI, was added. It revised the location of the Tanforan BART Station and extended the BART alignment south to Millbrae Avenue. New intersection counts were made for these new areas, including counts along Broadway in the City of Burlingame, and new intersections along Millbrae, El Camino Real, and California Avenue in Millbrae. Several key intersections from the September counts were recounted to provide a basis for adjusting the March, 1994, counts back to the September, 1993 baseline. The two traffic counting efforts provided traffic turning movement volumes at each of the 61 existing study area intersections.

Saturation flow counts at four major intersections along El Camino Real (at Chestnut, Sneath, San Bruno, and Millbrae) were used to independently verify the San Mateo County Congestion Management District's intersection capacity factors.

In addition to the existing 61 potential-BART-impact intersections, another 56 existing intersections and freeway ramps in or near the core Study Area were counted to provide data for the validation procedure. Also 38 tube counts were made near key intersections primarily to provide 24-hour data for the air quality analysis and model validation.

Freeway Counts

Peak hour and peak direction freeway traffic counts by lane were conducted for the critical section of Highway 101 between Third Avenue Interchange in San Mateo and I-380. Northbound counts in the a.m. and southbound counts in the p.m were conducted at five overcrossings: the Monte Diablo Avenue pedestrian overcrossing, Peninsula Avenue, Broadway, Millbrae Avenue and San Bruno Avenue. The freeway lane count showed an estimated average maximum capacity of 2,230 vehicles per hour (vph) per lane for this section of Highway 101. Freeway counts were also conducted at the two available overcrossings of I-280 at Sneath Lane and Crestmoor Drive as part of the model validation data.

2.4.2 Street, Highway and Intersection Traffic Projections

Modeling Strategy

A sub-area traffic computer model was developed to provide detailed highway and intersection turning movement projections not available from MTC's regional mode-choice

model. The MTC model incorporates only major arterials and highways into its roadway network, and its 700-zone system results in zones too large to accurately assign traffic at individual intersections around the stations areas.

The MTC model also does not provide the level of detail needed to estimate drive access volumes to individual BART stations. MTC models the transit and highway trips separately, with the drive-to-rail-transit-station trips in the transit network and not in the highway network. The MTC highway model provided the initial estimate of traffic travel speeds and levels of service on key arterials and highways needed for the MTC modeling trip distribution, mode-choice estimation, and station access mode choice estimation. However, the lack of a dynamic feedback between the two networks meant that the drive-to-BART auto trips on Highway 101 traveling to or from the southern-most BART station were not in the highway network assignment. Yet, the 500 or so BART-oriented peak-hour auto trips is sufficient to potentially increase congestion along Highway 101 and cause some BART users to seek other routes or to go to other BART stations, and for some of the background highway users to alter their trip routing. In particular, the City of San Bruno officials commented that they thought the 1991 MTC auto access projection to the Tanforan BART station was too low.

To provide a greater level of accuracy in the traffic modelling exercise, the project team employed TModel2, a traffic computer traffic network analysis program, to develop a sub-area traffic model. The model built on an earlier TModel2 traffic model used for the 1991 AA/DEIS/DEIR. The sub-area model incorporates the following basic elements.

- o Greater definition than the MTC model network for the street network in the study area including more local streets and intersections.

- o Disaggregation of the 700-zone system around alternative BART station locations in order to accurately portray likely access routes from these zones to BART stations or major arterials and highways, and to better distinguish the walk access from the auto access. The 49 MTC 700-zones of Super Districts 5 and 6 were split into 146 traffic analysis zones (TAZ's). The TAZ's were also congruent with the new San Mateo County zone system.

- o Remodeling of the auto access volumes to BART stations to determine the most likely station to be used by persons from any given zone. This was done to provide accurate estimates of parking demand at each station as well as to assure traffic volumes at local intersections included drive-to-BART trips.

- o The ability to analyze many more potentially impacted intersections then was done during the AA/DEIS/DEIR (19 intersections in the AA/DEIS/DEIR versus 92 in the revised DEIR/DEIS).

- o Improved traffic assignments. The MTC highway model assigns traffic volumes to streets based on the capacity of the street segments ("links"), whereas Tmodel2 assigns traffic based on the capacity of the intersections ("nodes"). Since the capacity of a real street system is established by the capacity of the critical intersections and not by the capacity of the street segments, TModel2 provided better representation of the real world conditions than MTC's regional model.

The sub-area model used MTC mode-choice projections as the starting point for the background (non-BART oriented) vehicle trips. For auto-only background trips the MTC-generated zone-to-zone volumes were used directly after being disaggregated to the 146 zone system developed for this study and adjusted to match the existing ground counts.

For the auto-access-to-BART trips, MTC's estimate of vehicle trips were split between the kiss-and-ride (KNR) and park-and-ride (PNR) trips (see Section 2.5 for a description of this process). The resulting BART PNR trips were then assigned by the subarea model.

Unlike the MTC model which assigns BART PNR trips to a particular station, the sub-area model assigned these trips based on their destination to a special BART network rather than a particular station. The special BART network consists of a series of one-way links leading from each alternative BART station to a BART destination zone in San Francisco. Based on a.m. peak hour travel times the model determined which BART station the PNR trips would access from each home zone. The assumption is that a drive-to-BART patron would choose the BART station based on primarily on the a.m. peak hour traffic conditions, and that the p.m. peak hour traffic conditions would have a lesser impact on station choice. The model captured these a.m. peak hour home-to-BART auto trips by station and then reversed them for the p.m. peak hour. Thus an afternoon PNR trip would leave from the same BART station, to return to its home traffic zone.

Each KNR trip was assigned as one auto trip to the BART station and one auto trip returning to the same origin zone. The KNR trips, unlike the PNR trips, were not dynamically assigned, but instead were distributed according to the MTC BART station trip distribution. This method was used because KNR trips are not relevant to the estimation of parking requirements at each BART station. In addition, the percentage of KNR trips is small relative to total PNR trips

and any improvement to be gained from a dynamic assignment would not be likely to affect traffic analysis results. Finally, KNR trips do not always behave like PNR trips because of the possibility that the KNR stop at a BART station is only an intermediate stop on a longer trip for the driver.

Intersection traffic turning movement projections were made for both the a.m. and p.m. peak hours, unlike the AA/DEIS/DEIR which analyzed only the p.m. peak hour because this period has the highest traffic volumes for almost all intersections. Freeway traffic projections for Highway 101 were done for what would be the peak direction for BART PNR users -- northbound toward the BART stations in a.m. and southbound from the BART stations in the p.m. -- because these times and directions would be potentially affected by a BART extension.

The intersection traffic turning movement and freeway volume projections were completed for the three years: 1993 (existing conditions), 1998 (year of opening), and 2010 (design year). For the select set of 26 intersections needed for air quality analysis, year 2000 projections were also made. TModel2 runs were made for eight alternatives for the years 1993 and 2010. For the intermediate years of 1998 and 2000, traffic turning movements and freeway volumes were extrapolated based on estimated growth rates as described in Section 2.2.

TModel2 traffic runs were completed for eight project alternatives with Alternatives V-A and V-B combined, since from a traffic point of view, the two alternatives are essentially identical. For both alternatives the end-of-line station would in effect be the San Bruno BART Station because in Alternative V-A, neither the park-and-riders nor kiss-and-riders would be attracted to the SFIA Ground Transportation Center (GTC) BART Station due to the parking costs, the general congestion in the terminal curb-side area, the difficulties facing pedestrians who would have to change multiple levels to access the BART platforms from the drop off zone, and the lack of a place for pickups to wait for their passengers.

Traffic Model Development and Validation

The TModel2 traffic network developed for this study expanded on the 1991 TModel2 network developed for the BART-SFO Extension AA/DEIS/DEIR. The smaller 1991 network was bounded by Hickey Boulevard and San Bruno Mountain on the north, the San Francisco Bay on the east, Millbrae Avenue on the south, and Skyline Boulevard (SR-35) on the west.

The enlarged network for the 1994 DEIR/DEIS was designed for additional functions -- to analyze traffic impacts of the BART extension alternatives on Highway 101 travel, to

provide a more detailed network capable of estimating the effect of traffic congestion on BART station choice, and to estimate the traffic turning movements for intersections impacted by the BART stations. To accurately predict any changes in the BART station access volumes, the model was enlarged to include all the zones within San Mateo County from which BART drive-access trips would occur. MTC projected drive-access to BART from Super Districts 5 and 6, an area extending from the San Francisco County line to the north, to the Belmont/San Carlos city boundaries to the south, with the Bay on the east and Pacifica and I-280 on the west. Exhibit 2.2 shows the full Tmodel2 sub-area network with the 146 internal TAZ centroids and ten external zone gateways. Exhibit 2.3 shows the street and highway-only parts of the Tmodel2 network (highways represented by bold lines). Exhibit 2.4 shows the BART park-and-ride and kiss-and-ride zones for ten alternative BART station locations, plus the special BART network connecting to Zone Centroid 202 in San Francisco.

Field verification of the number of travel lanes, the posted speed limits, and the type of intersection control was conducted for all links in the TModel2 network.

Variations of the network were developed for each alternative. The procedure was to define all the possible future roadway links and all alternative BART station sites as part of the No-Build network, and then to turn on or off the relevant links for each alternative and scenario. This strategy worked for the first set of alternatives developed in the Fall of 1993, but with the addition of Alternative VI in March of 1994, a new set of alternative networks had to be created. New networks had to be developed for the No-Build and TSM Alternatives, as well as Alternative VI, because the basis for comparing the effects of each build alternative is the No-Build and TSM Alternatives. Using the same strategy, a combined No-Build, TSM and Alternative VI network for the enlarged core study area was developed. This revised network included ten additional intersections for analysis. The revised No-Build network was verified against the original No Build assignments at link and turning movement level and against the enlarged set of ground counts.

The initial TModel2 network for the LPA Alternative and Alternatives I through V-B went through four validation steps as follows.

Validation Step 1 External zones - The starting point of the validation process is the disaggregated trip tables developed as described in Section 2.1.4. The external to external (X to X), the external to internal (X to I) and the internal to external (I to X) trips from the disaggregated vehicle trip table for the a.m. and p.m. existing conditions were adjusted to match ground counts at the ten external

Exhibit 2.2

TMODEL™2	BART/SFO ZONE CENTROIDS BART SFO REIR PARSONS BRINCKERHOFF, SAN FRANCISCO, CA	N6-20.LNX N6-20.NDE LL: 3036/20418 UR: 12215/30585 09-28-1994

Exhibit 2.3

TMODEL™2

BART/SFO HIGHWAY NETWORK

BART SFO REIR

PARSONS BRINCKERHOFF, SAN FRANCISCO, CA

N6-20.LNX
N6-20.NDE

LL: 3036/20418
UR: 12215/30585
09-28-1994

ZONE 202 IS SAN FRANCISCO DESTINATION NODE

○ BART STATIONS WITH PARK AND RIDE PARKING LOTS

Exhibit 2.4

TMODEL™2	BART/SFO SPECIAL BART NETWORK BART SFO REIR PARSONS BRINCKERHOFF, SAN FRANCISCO, CA	N6-20.LNX N6-20.NDE LL: 3018/20288 UR: 12115/30650 09-28-1994

zones using the Fratar process. Prior to Frataring, one trip was added to any zero volume matrix cell so that all TAZ's are represented during the Frataring (a multiplication process). The result provides directional volumes for each external zone matching the external screen line ground counts.

Validation Step 2 Willumsen's Method and Trip Table Mask - Willumsen's Method is used to estimate trip tables based on known ground counts. For this project, the method was used to adjust the disaggregated MTC-derived trip tables to better match the ground counts. The effect of the Willumsen run was to increase the number of vehicle trips in the trip table. This implies that the MTC model, which was validated at the major county line and Bay crossing screenlines, under-represented auto travel within the Study Area.

The accuracy of Willumsen's Method depends on the value of the "seed" or starting trip table, the quality of the traffic counts, and the location of the counts with respect to the zone structure. The "seed" trip table is the MTC regional trip table. The traffic counts were of a high quality, since the 117 intersection counts and 37 tube counts were in the core study area at and around the 61 analysis intersections, and these (plus the freeway counts of the key section of Highway 101), were all made by the study team during September, 1993 (or in March, 1994, and factored back to match the 1993 counts). For the less critical areas in the rest of the model network, Willumsen's method used recent counts available from other sources.

The original (pre-Frataring and pre-Willumsen Method) trip tables were subtracted from the output trip tables developed by the Willumsen process to provide a Trip Table Difference Mask. The a.m. and p.m. Trip Table Difference Masks were added to respectively to the a.m and p.m. trip tables developed as described in Section 2.1.4 for all the alternative scenarios, except for the existing 1993 a.m. and p.m. No-Build which used the ground counts directly.

Validation Step 3 Link difference mask - Due to the inherently coarse nature of the link, node and zone centroid structure of the traffic model network, the model outputs only approximates the real world when viewed at the micro scale. A.M. and p.m. link difference masks were developed to help compensate for inaccuracies in the model at the fine detail level. Output from the 1993 No-Build model run was subtracted from the existing ground counts at the link level to develop a link difference mask to help correct inconsistencies in the model output. The rationale is that since small scale inconsistencies are inherent the network itself, such inconsistencies should, by and large, be replicated equally for all the various alternatives.

Validation Step 4 Trip Table Adjustments - Using screenlines to establish traffic volumes at key locations, hand adjustments were made of the a.m. and p.m. Existing Trip Tables for areas with future street links not in the 1993 No Build conditions. In particular for the Hickey Extension from El Camino Real to Mission Road and Hillside, and for the extension of Sneath Lane to Herman Street in Alternative VI -- the trip table was hand adjusted to reduce the size of the link difference mask, so that the link mask itself would not introduce errors due to these network changes. After the hand adjustments the trip table and link difference masks were remade.

In summary, the traffic ground counts conducted in September of 1993 (and March of 1994) were used in the validation process five ways. First, the ground counts were compared with previous counts to help provide a 1990 to 1993 growth factor. Second, the ground counts were used to adjust the original trip tables using the Willumsen's Method to develop a trip table mask. Third, the output of the model run was subtracted from the ground counts at the link level to develop a link difference mask to help correct inconsistencies in the model output. Fourth, the ground count turning movements were used as the seed for the intersection Frataring process to convert link volumes into turning movements. Fifth, the ground counts were used to guide any additional hand adjustments to the modeled link volumes and turning movements that were required.

<u>Traffic Model Procedures</u>

Each traffic model run for a scenario (alternative and year) went through six steps as follows.

Model Run Step 1 Create and assign a.m. trip table - The disaggregated a.m. trip tables (creation described in Section 2.1.4) were imported into the TModel2 full matrix format, the "AM Trip Table Difference Mask" was then added, and the resultant trip table assigned to the network. The assigning process provides link volumes and turning movement volumes at each of the selected intersections.

Model Run Step 2 Capture BART trips - The a.m. TModel2 assignment included a select link assignment of each BART station entrance onto the special BART PNR network. Using this select link data TModel2 utilities helped to create a special file capturing a.m. BART PNR trip station assignments. This data was then transposed to form the p.m. peak hour BART PNR trip table.

Model Run Step 3 Create and assign p.m. trip table - The disaggregated p.m. trip tables (creation described in Section 2.1.4) were imported into the TModel2 full matrix format, and the "PM Trip Table Difference Masks" added. Next, the BART PNR trips from the MTC-based p.m. trip table

were removed, and replaced with the BART PNR trips from Step 2. The resultant trip table was assigned to the network.

Model Run Step 4 Add link difference mask - For the a.m. and p.m. model runs the respective "AM" and "PM Link Difference Masks" were added to the Step 3 assignment link volumes.

Model Run Step 5 Develop turning movement files. - At the turning movement level the traffic model only roughly approximates the real world. In order to improve on the model, existing turning movement volumes were used to adjust the modeled turning movements. To provide "seed" turning movements for the adjustment, the existing turning movements were merged with the modeled turning movements. The merge utility replaced the modeled turning movements with the existing where available, and used the modeled turning movements only where existing turning movements were not available - namely future intersections and locations such as entrances to the future BART station where the turning movement does not presently exist. The merged turning movement for each intersection is then Fratared so that the sum of the approach and exit volumes equals the adjusted link volumes from Step 4. Lastly the bus turning movements appropriate for each alternative and year was manually added to the turn volume data file.

Model Run Step 6 Hand Adjust turn movements - Hard copies of the 1993 and 2010 turn volume files were compared with the existing turn volumes, the forecast turn volumes for the other scenario years and for the other alternatives for the same year. Based on planning judgement, additional hand adjustments to the turning movements were made to improve consistency between the alternatives and scenarios.

Model Run Step 7 Interpolate 1998 and 2000 forecasts - Any hand adjustments to the turning movements for the 1993 and 2010 scenarios were entered back into the turning movement volume data files. After checking for accuracy of input, the two intermediate year scenarios of 1998 and 2000 were interpolated. The year 1998 was projected to have 52 percent of the growth that would occur from 1993 to 2010 and the year 2000 to have 72 percent of the growth.

Traffic Model Results

Intersections - Appendices A - H provide the projected turning movement volumes for the nine alternatives for the 1993, 1998, 2000 and 2010 scenario years. Alternatives V-A and V-B in terms of traffic impacts are identical and so they have been combined in one volume, Appendix G.

Freeways - The the peak hour and peak direction freeway volumes projections for the section of Highway 101 between

Airport Boulevard in South San Francisco and Third Avenue in San Mateo are reported in the Draft EIR.

2.5 PARKING PROJECTIONS

The MTC mode-choice model provided the basis for projecting parking requirements at each BART station. A direct output of the model was the number of daily BART riders who would access each station by auto. However, because of the simplified street network and relatively large analysis zones (the 700-zone system) used within the study area, it was recognized that additional analysis would be required to accurately project parking demand. This additional analysis was conducted through the traffic modelling exercise.

The projected 2010 daily BART station auto access person trips generated by the MTC model for the entire extension (from the Colma station to the end-of-line station for each alternative) was created by summing each station's auto access volumes. This total pool of auto access trips was then converted to peak hour vehicle trips and added to the vehicle trip table used for the traffic analysis as described in Section 2.1.4.

The traffic model (TModel) was then used to assign the BART auto access vehicle trips to the best station considering the origin zone of the trip, travel times, traffic conditions, and other factors included as part of the traffic assignment algorithm. The output was peak hour auto access trip assignments for each BART station on the extension. These peak hour values were then converted back to daily auto access person trip values and the total daily parking demand at each station estimated. An implicit assumption in this process is that none of the BART stations on the SFIA extension would be constrained with regard to parking availability. This assumption has the effect of producing an estimate of parking demand at each station regardless of how many spaces would actually be provided. This was deemed a reasonable assumption in light of BART's plan to provide sufficient parking at each station to meet demand.

In order to make the conversion from the reassigned daily auto access person trips to parking demand, some additional assumptions were required. First, based on the assignment of vehicles to each BART station and preliminary information regarding the number of parking spaces to be provided, it was determined that all BART stations on the extension should be treated as having an unconstrained parking supply. The exception was the Colma station where it was found the parking demand essentially equaled the total supply provided under existing plans.

Second, it was assumed that there would be no parking turnover (i.e. two cars arriving at different times of day could not use the same parking space). This assumption tends to slightly increase the estimate as to the number of spaces required, but was deemed appropriate for this analysis to assure all parking demand would be accounted for and, therefore, abate concerns expressed by local communities that parking spillover (into adjacent neighborhoods) might occur.

Third, it was assumed that there would be some parking at BART stations for non-work trips purposes. This is contrary to the assumption used in the MTC model, but is supported by BART survey data (1987 Passenger Profile On-Board Survey) which indicates about 50 percent of non-work trips access BART stations via automobile.

Review of BART patron survey data revealed the BART patron station access characteristics shown in Table 2.16. Using these factors and accounting for the assumptions described above, a total parking demand at each station was projected for the year 2010. These parking volumes appear in the EIS/EIR for this project.

TABLE 2.16
BART STATION AUTO ACCESS ASSUMPTIONS

AUTO SUB-MODES	PERCENT AT PARKING CONSTRAINED STATIONS	PERCENT AT PARKING UNCONSTRAINED STATIONS	AUTO OCCUPANCY
Drive Alone	53.0	56.8	1.0
Shared Ride	15.0	16.5	2.3
Kiss-and-Ride	32.0	26.7	1.0
	100.0	100.0	

Source: BART, 1987 Passenger Profile On-Board Survey

2.6 PEDESTRIAN PROJECTIONS

Pedestrian projections consist of estimates of the number of BART patrons who would walk to their BART station of choice. Daily estimates of walk access to BART stations is provided directly by the MTC model. For the transportation analysis, the peak period was the focus because the largest concentration of pedestrian activity occurs during these time periods. To estimate peak period BART station walk access, the MTC-generated daily values were converted to peak hour volumes using the peaking factors presented in Table 2.5.

3.0 TRAFFIC CONDITIONS ANALYSIS METHODOLOGY

3.1 INTERSECTION ANALYSIS

This section describes the methodology used to analyze the 61 intersections. See Section 2.4 above for the selection process of the 61 intersections and methods used to project traffic volumes. The existing intersection geometry and traffic control was observed as part of the data collection for the 61 intersections. The type of traffic control for each analyzed intersection for each alternative scenario is delineated in Table 2.15. Appendixes A - H show the results of the intersection analysis for all analyzed intersections and alternative scenarios.

3.1.1 Signalized Intersections

All existing and future signalized intersections were analyzed using the Circular 212 analysis methodology available in the NCAP intersection analysis computer program. The procedure uses the projected turning movement volumes, the number of turning and through traffic lanes, and the traffic signal operations to determine the traffic level of service for the whole intersection over the course of one hour. The procedure provides a volume over capacity (v/c) ratio and a corresponding traffic Level of Service (LOS).

Table 3.1 describes traffic LOS designations for signalized intersections. The LOS provides a grading of the level of service for the intersection from A to F. An LOS A means excellent free flow conditions, while an LOS E represents congested conditions when the maximum volume is moving through the intersection. LOS F represents a condition where the traffic volume exceeds the capacity, traffic becomes jammed and the actual volume moving through the intersection begins to fall.

The Circular 212 procedure uses a "critical lane" methodology. The methodology determines which traffic lanes approaching the intersection are critical in determining the duration of green signal phases. For a particular traffic signal phase the critical lane is the lane with the highest traffic volume that opposes another critical lane. For example, a southbound through lane opposing a northbound left-turn lane. The combination of critical lane volumes for the intersection as a whole is summed and compared with the critical lane capacity of the intersection as a whole to provide a v/c ratio. For the Circular 212 procedure the effect of the intersection clearance time (the yellow and all-red time) and of multiple signal phases is approximated as a maximum sum of critical volumes for each LOS.

TABLE 3.1: VEHICULAR LEVELS OF SERVICE AT SIGNALIZED INTERSECTIONS

Level of Service	Description	Volume/Capacity (v/c) Ratio/a/
A	Level of Service A describes a condition where the approach to an intersection appears quite open and turning movements are made easily. Little or no delay is experienced. No vehicles wait longer than one red traffic signal indication. The traffic operation can generally be described as excellent.	0.00-0.60
B	Level of Service B describes a condition where the approach to an intersection is occasionally fully utilized and some delays may be encountered. Many drivers begin to feel somewhat restricted within groups of vehicles. The traffic operation can generally be described as very good.	0.61-0.70
C	Level of Service C describes a condition where the approach to an intersection is often fully utilized and back-ups may occur behind turning vehicles. Most drivers feel somewhat restricted, but not objectionably so. The driver occasionally may have to wait more than one red traffic signal indication. The traffic operation can generally be described as good.	0.71-0.80
D	Level of Service D describes a condition of increasing restriction causing substantial delays and queues of vehicles on approaches to the intersection during short times within the peak period. However, there are enough signal cycles with lower demand such that queues are periodically cleared, thus preventing excessive back-ups. The traffic operation can generally be described as fair.	0.81-0.90
E	Capacity occurs at Level of Service E. It represents the most vehicles that any particular intersection can accommodate. At capacity there may be long queues of vehicles waiting up-stream of the intersection and vehicles may be delayed up to several signal cycles. The traffic operation can generally be described as poor.	0.91-1.00
F	Level of Service F represents a jammed condition. Back-ups from locations downstream or on the cross street may restrict or prevent movement of vehicles out of the approach under consideration. Hence, volumes of vehicles passing through the intersection vary from signal cycle to signal cycle. Because of the jammed condition, this volume would be less than capacity.	1.01+

/a/ Capacity is defined as Level of Service E.

SOURCE: San Francisco Department of Public Works, Traffic Division, Bureau of Engineering from Highway Capacity Manual, Highway Research Board, 1965.

The sum of critical lane traffic flow values used to calculate the v/c ratio is the same as that used by the San Mateo County Congestion Management Agency. This is a higher volume than the default values used in the original Circular 212 procedure. The project team measured the saturation flow rate at four major intersections along El Camino Real at Chestnut, Sneath, San Bruno and Millbrae. The results confirmed the critical flow values used by the County. Table 3.2.A provides the extrapolated maximum sum of critical lane values for each LOS level as by the Circular 212 method.

Four signalized study intersections are adjacent to railroad crossing gates: Broadway/California Drive, Millbrae Avenue/El Camino Real, San Bruno Avenue/San Mateo Avenue and San Bruno Avenue/Huntington Avenue. The gate down time for a passing train represents lost time for the adjacent intersection in two ways. With the gate down most of the possible traffic turning movements are blocked. For the rest of the traffic movements that can move while the gate is down, such through movements for the street parallel to the tracks, the traffic flow rate is less than capacity, because the up-stream intersections cannot feed the intersection continually at the saturation flow rate. That is, during the time the gate is down there will be lengthening of gaps between the vehicles. For both the blocked movements and the parallel movements the capacity of the intersection is reduced.

Field observations were made of the time the gates were down during the AM and PM peak hours. On the average the gate is down an average 11 percent of the time for both peak hours. Table 3.2.B shows the sum of the critical movements if the gate is down 11 percent of the time.

For the future conditions for the years 1998 and 2010, the present 60 trains a day would be increased to 86 trains per day. The 86 train schedule is the equilibrated value developed during the 1992 AA/DEIS/DEIR. The MTC equilibration process started with a 114 trains per day schedule assumed in the Peninsula Commute Service San Francisco Downtown Station Relocation Study. Table 3.2.C shows the average sum of critical movements for an 86 trains per day schedule, calculated for the gates down time of 15 percent during the peak hour.

Exhibit 3.1 provides an example of the NCAP output for the Circular 212 calculation. Most of the calculation sheet is self-explanatory. Steps 1 and 2 show the input for the lane geometry and turning movements. Step 3 shows the input for the signal phasing. The phasing is that observed in the field, except for a few cases where the phasing was modified to compensate for the inability of the NCAP program under a few conditions to properly handle right-turn volumes when calculating the sum of critical volumes. Step 5 splits the

Table 3.2
SIGNALIZED INTERSECTION LEVEL OF SERVICE
Circular 212 Methodology
BART/SFO EXTENSION STUDY

Table 3.2.A
LEVEL OF SERVICE FOR ALL INTERSECTIONS
EXCEPT RAILROAD CROSSINGS
ADDJUSTED FOR SAN MATEO COUNTY

LEVEL OF SERVICE	MAXIMUM SUM OF CRITICAL VOLUMES		
	TWO PHASE SIGNAL	THREE PHASE SIGNAL	FOUR + PHASE SIGNAL
A	1140	1080	1040
B	1330	1270	1220
C	1520	1440	1390
D	1710	1610	1550
E	1900	1800	1740
F	0	0	0

Table 3.2.B
LEVEL OF SERVICE FOR INTERSECTIONS
NEXT TO RAILROAD CROSSINGS FOR 1993
WITH GATE DOWN 11% OF THE TIME

LEVEL OF SERVICE	MAXIMUM SUM OF CRITICAL VOLUMES		
	TWO PHASE SIGNAL	THREE PHASE SIGNAL	FOUR + PHASE SIGNAL
A	1015	961	926
B	1184	1130	1086
C	1353	1282	1237
D	1522	1433	1380
E	1691	1602	1549
F	0	0	0

Table 3.2.C
LEVEL OF SERVICE FOR INTERSECTIONS
NEXT TO RAILROAD CROSSINGS FOR 1998 & 2010
WITH GATE DOWN 15% OF THE TIME

LEVEL OF SERVICE	MAXIMUM SUM OF CRITICAL VOLUMES		
	TWO PHASE SIGNAL	THREE PHASE SIGNAL	FOUR + PHASE SIGNAL
A	969	918	884
B	1131	1080	1037
C	1292	1224	1182
D	1454	1369	1318
E	1615	1530	1479
F	0	0	0

```
                              Critical Movement Analysis: PLANNING
                                      Calculation Form 1
Intersection: INT#23 JUNIPERO SERRA AND WESTBOROUGH                 Design Hour: PM BART/SFO 1/10/94
Problem Statement: LPA10
==================================================================================================
Step 1. IDENTIFY LANE GEOMETRY      | Step 4. LEFT TURN CHECK              | Step 6b. VOLUME ADJUSTMENT FOR    |
            | Approach 3:JUNIPERO SERR|                   -------Approach-----|          MULTIPHASE SIGNAL OVERLAP|
            |  1 2   1 |       ^      |                   : -1-  -2-  -3-  -4-|       Possible    Volume   Adjusted|
            |  R   L   |       N      |a.No. of change    :  0    0    0    0|Prob- Critical  Carryover  Critical|
WESTBOROUGH | R T T T L|              | intervals/hour    :                   |able   Volume   to next    Volume |
------------  T H H H T  -------------|b.LT capacity on   :  0    0    0    0|Phase  in vph    phase     in vph |
 Approach 1   < < | > >   ^--RT       | change (vph)^     :                   |-----------------------------------|
   1  LT--^     v v v    <^-RTH  1    |c.G/C ratio        :  0    0    0    0|A4B3  513(A4) OR  470(B3)      513|
      LTH-^>             <--TH   1    |d.Opposing volume  :  0    0    0    0|A3B4  216(A3) OR  132(B4)      216|
   1  TH-->              <v-LTH       | in vph            :                   |A1B2  144(B2)  653- 144= 509(A1)  144|
   1  RTH-v>    ^ ^ ^     v--LT  1    |e.LT capacity on   :  0    0    0    0|A1A2  509(A1)  646- 509= 137(A2)  509|
      RT--v   < < | > >  Approach 2   | green (vph)       :                   |A2B1  253(B1) OR  137(A2)      253|
------------  L L T R R  -------------|f.LT capacity in   :  0    0    0    0|                                   |
            | T T H T T |WESTBOROUGH  | vph (b+e)         :                   |                                   |
            |   H   H   |             |g.Left turn volume :  0    0    0    0|                                   |
            | 2 1   1   |             | in vph            :                   |                                   |
            | Approach 4:JUNIPERO SERR|h.Is volume > cap. : NO   NO   NO   NO:|                                   |
            |                         | (g>f) ?           :                   |                                   |
======================================+=======================================+===================================
Step 2. IDENTIFY VOLUMES, in vph      | Step 5. ASSIGN LANE VOLUMES, in vph   | Step 7. SUM OF CRITICAL VOLUMES
                                      |        |                  |           |
            | Approach 3|             |        | 1 1 2 2 1        |           |513(A4)+216(A3)+653(B2A1)+253(B1)
3:  LT= 132 |           | 2:RT= 178   |------- 0 1 1 1 3          -------     |
    TH= 545 | |         |   TH=1115   |        2 4 6 6 2          ^+ 178      |        = 1635 vph
    RT= 102 | v         |   LT= 253   |        + + | | |          <+ 468      |===================================
-------------           --------------|        < v v v >          <- 646      | Step 8. INTERSECTION LEVEL OF
                        <--Approach 2 |                           v- 253      |      SERVICE
                                      |                                       |   (compare step 7 with table 6)
                                      |                                       |          -------
Approach 1-->                         | 144 -^                                |          | E |
-------------           --------------| 653 ->          < < < ^ ^ >           |          -------
1:LT= 144   |         ^ | 4: RT=  77  | 129 +>          | | + + + +           |===================================
  TH= 782   |         | |    TH= 637  | 524 +v                                | Step 9. RECALCULATE
  RT= 524   |           |    LT=1116  |-------          4 3 2 2 4    -------  |
            | Approach 4|             |        |        7 8 6 0 3 7 |         |Geometric Change:
                                      |        |        0 4 0 1 6 7 |         |Signal Change:
                                      |                                       |Volume Change:
======================================+=======================================+===================================
Step 3. IDENTIFY PHASING              | Step 6a. CRITICAL VOLUMES, in vph     | COMMENTS
                                      |          (two phase signal)           |
         <   ^   A4B3                 |          | Approach 3|                |DEFAULT ADJUSTMENT FACTORS WERE REVISED
         |   |                        |          |           |                |
         |   |   A3B4                 |          |           |                |
         v   >                        |          |           |                |
       --^       A1B2                 |-------------         -------------    |
       -->                            |  Approach 1                           |
       --> <--   A1A2                 |                                       |
                                      |         See Step 6b.                  |
           <--   A2B1                 |                                       |
           v--                        |                       Approach 2      |
                                      |-------------          ------------    |
                                      |          |           |                |
--------------------------------------|          |           |                |
A1 -->   A3 |      B1 v--    B3   <|  |          |           |                |
            v ^                   |   |          | Approach 4|                |
A2 <--   A4   |    B2 --^    B4  |>   |                                       | V/C Ratio = .94
==================================================================================================
```

Exhibit 3.1
Sample Intersection Calculation Sheet for Signalized Intersections

volumes over the various lanes. Step 7, the sum of critical volumes, was manually checked for correctness. Step 8 the LOS and the v/c ratio are based on the LOS criteria shown in Table 3-2.

A special spreadsheet was developed to apply the circular 212 methodology to the five-legged intersection of Broadway, Rollins Road and the US-101 southbound off-ramp.

3.1.2 Unsignalized Intersections

Two types of unsignalized intersections were analyzed: two-way stop sign controlled, and all-way stop sign controlled.

Two-way Stop Control

A two-way-stop-sign-controlled intersection has no control for the major street and stop signs for the side street. These intersections were analyzed using the Highway Capacity Manual procedure for unsignalized intersections available in the NCAP program. The procedure calculates the available gaps in the major traffic stream for the all the other traffic movements that must cross this stream. Each movement, such as left-turns off the major street or the through movement for the side street, has a different critical gap that the driver would wait for (accept) before making the movement. The critical gap for each movement is based on factors such as the speed of the major street traffic, turning radiuses, and presence of an acceleration lane.

The methodology calculates the total seconds of gaps available based on lane geometry and main street through traffic volume. It then subtracts from this total the various critical gap times that all the other traffic movements require. The amount of time remaining is called the *reserve capacity*. The traffic level of service for each movement is calculated based on the reserve capacity for that movement (see Table 3.3).

Exhibits 3.2 and 3.3 show representative NCAP output for "T" intersections and four-legged intersections respectively. Unlike the output for signalized intersections there is no combined LOS for the intersection as a whole. Rather each movement has its own LOS. If, however, a lane has more than one movement, for example a single lane approach, then the LOS is also shared. At the bottom of the calculations on Exhibit 3.2, the column "LOS CM" shows the LOS for a single lane, and column "LOS CSH" shows the LOS if the lane is shared. If a lane shares turning movements then the shared lane LOS should be used.

Table 3.3
Level of Service Criteria
for Two-way Stop Sign Controlled Intersections

Reserve Capacity (PCPH)	Level of Service	Expected Delay to Minor Street Traffic
> = 400	A	Little of no delay
300-399	B	Short traffic delays
200-299	C	Average traffic delays
100-199	D	Long traffic delays
0- 99	E	Very long traffic delays
*	F	*

* When demand volume exceeds the capacity of the lane, extreme delays will be encountered with queuing which may cause severe congestion affecting other traffic movements in the intersection. This condition usually warrents improvement to the intersection.

Source: Transportation Research Board, National Research Council, *Special Report 209, Highway Capacity Manual,* 1985, Table 10-3.

```
LOCATION:INT38 DOLLAR/HERMAN & TANFORAN |NAME:ALT 8 5/6/94
---------------------------------------------------------------------------
HOURLY VOLUMES                          | VOLUMES IN PCPH
                               <N       |
 Major street:DOLLAR                    |
======================================= | ===================================
N= 1                   <---V5---  118   |
Grade   168---V2--->   v---V4---   43   |              <---V5---
  0%    21---V3---v           N= 1      |      ---V2--->     v---V4---   47
================  <|    |>  =========   |      ---V3---v
Date of Counts:  |  |    |  |           | ================  <|   |>  ========
2010             |  V7   V9 |  X STOP   |                 |  |   |  |
Time Period:     |  |    |  |    YIELD  |                 | V7  V9  |
PM               |  40    72|           |                 | |   |   |
Approach Speed: Minor Street:   Grade   |                 | 44   79 |
              TANFORAN          0%      |
PHF:                N= 2
Population: 1000000
===========================================================================
VOLUME ADJUSTMENTS
---------------------------------------------------------------------------
Movement no.             |   2   |   3   |   4   |   5   |   7   |   9   |
---------------------------------------------------------------------------
Volume (vph)             |  168  |   21  |   43  |  118  |   40  |   72  |
---------------------------------------------------------------------------
Vol(pcph),see Table 10.1|XXXXXXXX|XXXXXXXX|  47  |XXXXXXXX|  44  |   79  |
===========================================================================
STEP 1 : RT From Minor Street           |          /-> V9
===========================================================================
Conflicting Flows, Vc                   | 1/2 V3+V2= 11 + 168 = 179 vph(Vc9)
Critical Gap, Tc                        | Tc=    5 secs (Tab.10.2)
Potential Capacity, Cp                  | Cp9= 1000 pcph (Fig.10.3)
Actual Capacity, Cm                     | Cm9=Cp9= 1000 pcph
===========================================================================
STEP 2 : LT From Major Street           |          v-- V4
===========================================================================
Conflicting Flows, Vc                   | V3+V2= 21 + 168 = 189 vph(Vc4)
Critical Gap, Tc                        | Tc=  4.5 secs (Tab.10.2)
Potential Capacity, Cp                  | Cp4= 1000 pcph (Fig.10.3)
% of Cp utilized and Impedance Factor   | (V4/Cp4)x100=  4.7% P4= .97
Actual Capacity, Cm         (Fig.10.5)  | Cm4=Cp4= 1000 pcph
===========================================================================
STEP 3 : LT From Minor Street           |          <-\ V7
===========================================================================
Conflicting Flows, Vc                   | 1/2 V3+V2+V5+V4=
                                        | 11 + 168 + 118 + 43 = 340 vph(Vc7)
Critical Gap, Tc                        | Tc=    6 secs (Tab.10.2)
Potential Capacity, Cp                  | Cp7=  673 pcph (Fig.10.3)
Actual Capacity, Cm                     | Cm7=Cp7xP4= 673 x .97 = 653 pcph
===========================================================================
SHARED LANE CAPACITY    SH = (V7+V9)/((V7/Cm7)+(V9/Cm9)) if lane is shared

                                                  CR       CR     LOS   LOS
MOVEMENT   V(PCPH)   CM(PCPH)   CSH(PCPH)     (CM-V)   (CSH-V)    CM    CSH
===========================================================================
    7         44        653                     609                A
    9         79       1000                     921                A
    4         47       1000                     953                A
```

Exhibit 3.2
Sample Intersection Calculation Sheet for Two-Way Stop "T" Intersections

```
LOCATION:ALT 8 INT #49                      NAME:SECOND AND SAN BRUNO
-------------------------------------------------------------------------------
HOURLY VOLUMES              Grade 0%
                           |          N = 1       |
                           |  40                  |
                           | V12                  |        ^
                           |  |    1              |        N
                           |  |  V11              |
                           |  |   |    5          |
 ==========================|  |   |  V10          ==========================
      N= 2                   <|   v   |>         ^----------V6-- 25
Grade 0%                                         <----------V5-- 1023 N= 2
      72 --V1------------^                       v----------V4-- 93
     867 --V2------------>                          major road        Grade 0%
      27 --V3------------v       <|   ^       |>    SAN BRUNO
 ==========================       V7  |       |  ==========================
                           |      20  |       |  | STOP xx
                           |          V8      |  | YIELD
                           |  N= 1    12      |  | Date of Counts:2010
                           |                 V9  | Time Period:PM
                           | minor road      38  | Prevailing Speed:
                           | SECOND              | PHF:
                           |   Grade 0 %         | Population:1000000
===============================================================================
VOLUME ADJUSTMENTS
-------------------------------------------------------------------------------
```

Movement no.	1	2	3	4	5	6	7	8	9	10	11	12
Volume (vph)	72	867	27	93	1023	25	20	12	38	5	1	40
Vol(pcph),Tab.10.1	79	XXXX	XXXX	102	XXXX	XXXX	22	13	42	6	1	44

```
VOLUMES IN PCPH            |                      |
                           |  44                  |
                           | V12                  |
                           |  |    1              |
                           |  |  V11              |
                           |  |   |    6          |
 ==========================|  |   |  V10          ==========================
                             <|   v   |>         ^----------V6-- ==
                                                 <----------V5-- ==
      79 --V1------------^                       v----------V4-- 102
      == --V2------------>
      == --V3------------v       <|   ^       |>
 ==========================       V7  |       |  ==========================
                           |      22  |       |  |
                           |          V8      |  |
                           |          13      |  |
                           |                 V9  |
                           |                 42  |
```

Exhibit 3.3, page 1 of 3
Sample Intersection Calculation Sheet
for Two-Way Stop 4-Leg Intersections

LOCATION:ALT 8 INT #49 NAME:SECOND AND SAN BRUNO

STEP 1 : RT From Minor Street	/-> V9	<-/ V12
Conflicting Flows, Vc	1/2 V3+V2=Vc9 14+ 434= 448 vph	1/2 V6+V5=Vc12 13+ 512= 525 vph
Critical Gap, Tc (Tab.10.2)	5 (secs.)	5 (secs.)
Potential Capacity,Cp(Fig10.3)	Cp9 = 757 pcph	Cp12 = 690 pcph
% of Cp utilized	(V9/Cp9)x100= 5.5%	(V12/Cp12)x100= 6.4%
Impedance Factor, P (Fig.10.5)	P9= .97	P12= .96
Actual Capacity, Cm	Cm9=Cp9= 757 pcph	Cm12=Cp12= 690 pcph

STEP 2 : LT From Major Street	v-- V4	--^ V1
Conflicting Flows, Vc	V3+V2=Vc4 27+ 867= 894 vph	V6+V5=Vc1 25+ 1023= 1048 vph
Critical Gap, Tc (Tab.10.2)	5 (secs.)	5 (secs.)
Potential Capacity,Cp(Fig10.3)	Cp4 = 449 pcph	Cp1 = 371 pcph
% of Cp utilized	(V4/Cp4)x100= 22.7%	(V1/Cp1)x100= 21.3%
Impedance Factor, P (Fig.10.5)	P4= .84	P1= .85
Actual Capacity, Cm	Cm4=Cp4= 449 pcph	Cm1=Cp1= 371 pcph

STEP 3 : TH From Minor Street	^ V8	v V11
Conflicting Flows, Vc	.5V3+V2+V1+V6+V5+V4=Vc8 14+ 867+ 72+ 25+ 1023+ 93= 1700 vph	.5V6+V5+V4+V3+V2+V1=Vc11 13+ 1023+ 93+ 27+ 867+ 72= 1700 vph
Critical Gap, Tc (Tab.10.2)	6 (secs.)	6 (secs.)
Potential Capacity,Cp(Fig10.3)	Cp8 = 105 pcph	Cp11 = 105 pcph
% of Cp utilized	(V8/Cp8)x100= 12.4%	(V11/Cp11)x100= 1%
Impedance Factor, P (Fig.10.5)	P8= .92	P11= .99
Actual Capacity, Cm	Cm8=Cp8xP1xP4 75= 105x.85x.84pcph	Cm11=Cp11xP1xP4 75= 105x.85x.84pcph

STEP 4 : LT From Minor Street	<-\ V7	\-> V10
Conflicting Flows, Vc	Vc8(step3)+V11+V12=Vc7 1700+ 1+ 40= 1700vph	Vc11(step3)+V8+V9=Vc10 1700+ 12+ 38= 1700vph
Critical Gap, Tc (Tab.10.2)	6.5 (secs.)	6.5 (secs.)
Potential Capacity,Cp(Fig10.3)	Cp7 = 85 pcph	Cp10 = 85 pcph
Actual Capacity, Cm	Cm7=Cp7xP1xP4xP11xP12 = 85x.85x.84x.99x.96 = 58 pcph	Cm10=Cp10xP4xP1xP8xP9 = 85x.84x.85x.92x.97 = 54 pcph

LOCATION:ALT 8 INT #49 NAME:SECOND AND SAN BRUNO

SHARED LANE CAPACITY

APPROACH MOVEMENTS 7,8,9

MOVEMENT	V(PCPH)	CM(PCPH)	CSH(PCPH)	CR (CM-V)	CR (CSH-V)	LOS CM	LOS CSH
7	22	58	127	36	50	E	E
8	13	75	127	62	50	E	E
9	42	757	127	715	50	A	E

APPROACH MOVEMENTS 10,11,12

MOVEMENT	V(PCPH)	CM(PCPH)	CSH(PCPH)	CR (CM-V)	CR (CSH-V)	LOS CM	LOS CSH
10	6	54	271	48	220	E	C
11	1	75	271	74	220	E	C
12	44	690	271	646	220	A	C

MAJOR STREET LEFT TURNS 1,4

MOVEMENT	V(PCPH)	CM(PCPH)	CR(CM-V)	LOS
1	79	371	292	C
4	102	449	347	B

COMMENTS:

All-way stop control

An all-way stop control intersection has a stop sign for each approach. The capacity of the intersection is highest when the approach volumes of the two cross street are approximately equal. An uneven demand between the two cross streets means that the driver must take more time to decide if it is his or her turn to enter the intersection.

Table 3.4 shows the LOS for all-way stop intersections with one or two approach lanes and different ratios of traffic demand for the cross streets. A two-lane street means one lane in each direction, and a four-lane street has two lanes in each direction. The table is a composite extrapolated from the three tables on the capacity of all-way stops in the 1985 Highway Capacity Manual.[1] A spreadsheet was developed to do the calculations and to provide a standardized output (see Exhibit 3.4).

3.2 FREEWAY ANALYSIS

3.2.1 Highway 101 Mainline

The Highway 101 mainline from the Third Avenue interchange in San Mateo to the Airport Boulevard interchange in South San Francisco was analyzed for traffic level of service. As described in Section 2.4.1 the observed average mainline capacity for this section is 2230 vph per lane. The 2230 vph is the actual vehicle count and so includes heavy vehicles and the average impact for the merges, diverges, and weaving sections. Table 3.5 shows the LOS criteria used for the Highway 101 freeway mainline based on the latest Highway Capacity Manual adjusted to match the observed average lane capacity. Table 3.6 describes the levels of service for freeway segments.

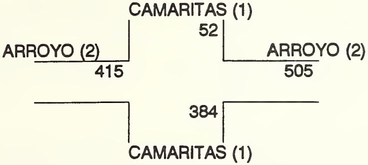
3.2.2 Weave Analysis

As per Caltrans' request the southbound Highway 101 weave between the San Bruno Avenue Collector Road on-ramp and the Millbrae Avenue off-ramp was estimated for the PM peak hour. The weaving impact estimation used an adjusted version of the Caltrans' "Procedure for Analysis and Design of Weaving Sections, A Users Guide," (1984).[2] The Users Guide assumes 2000 vph per as the maximum capacity for a freeway lane. The adjustment was to increase the maximum per lane volume to match the observed per lane volume.

---

1. Transportation Research Board, National Research Council, *Special Report 209, Highway Capacity Manual*, (1985), Tables 10-5, 10-6, and 10-7.
2. Jack E. Leisch & Associates, "Procedure for Analysis and Design of Weaving Sections, A Users Guide," 1983, completed under the FHWA Project DFTH61--82-C-00050.

ALL–WAY STOP CONTROLLED INTERSECTION––LEVEL OF SERVICE ANALYSIS
INTERSECTION: INT #22 CAMARITAS AND ARROYO
ALTERNATIVE: LPA 2010 (PM)



VOLUME OF INTERSECTION = 1356

DEMAND SPLIT RATIO (1)= 0.32

DEMAND SPLIT RATIO (2)= 0.68

NORTH BOUND	SOUTH BOUND	EAST BOUND	WEST BOUND	
190	12	9	262	L
74	36	224	227	T
120	4	182	16	R

NUMBER OF LANES NORTH AND/OR SOUTH= 4
NUMBER OF LANES EAST AND/OR WEST= 4

LOS A
LOS B
LOS C
LOS D
LOS E
LOS F

* Level of service procedure found in Chapter 10 of the Highway Capacity Manual.

LEVEL OF SERVICE	TWO-BY-TWO LANE -- SERVICE VOLUME, VPH				
	50/50 D-SPLIT	55/45 D-SPLIT	60/40 D-SPLIT	65/35 D-SPLIT	70/30 D-SPLIT
A	0 - 760	0 - 720	0 - 680	0 - 640	0 - 610
B	760 - 980	720 - 930	680 - 880	640 - 830	610 - 790
C	980 - 1200	930 - 1140	880 - 1080	830 - 1020	790 - 965
D	1200 - 1630	1140-1550	1080-1470	1020 - 1390	965 - 1315
E	1630 - 1900	1550 - 1800	1470 - 1710	1390 - 1620	1315 - 1530
F	> 1900	>1800	>1710	>1620	>1530

LEVEL OF SERVICE	TWO-BY-FOUR LANE -- SERVICE VOLUME, VPH				
	50/50 D-SPLIT	55/45 D-SPLIT	60/40 D-SPLIT	65/35 D-SPLIT	70/30 D-SPLIT
A	0 - 1160	0 - 1110	0 - 1065	0 - 1020	0 - 980
B	1160 - 1480	1110 - 1420	1065 - 1360	1020 - 1305	980 - 1255
C	1480 - 1800	1420 - 1730	1360 - 1660	1305 - 1590	1255 - 1530
D	1800 - 2420	1730 - 2325	1660 - 2230	1590 - 2140	1530 - 2060
E	2420 - 2800	2325 - 2690	2230 - 2580	2140 - 2480	2060 - 2380
F	> 2800	>2690	>2580	>2480	>2380

LEVEL OF SERVICE	FOUR-BY-FOUR LANE -- SERVICE VOLUME, VPH				
	50/50 D-SPLIT	55/45 D-SPLIT	60/40 D-SPLIT	65/35 D-SPLIT	70/30 D-SPLIT
A	0 - 1345	0 - 1270	0 - 1200	0 - 1135	0 - 1070
B	1345 - 1770	1270 - 1675	1200 - 1580	1135 - 1495	1070 - 1410
C	1770 - 2200	1675 - 2080	1580 1965	1495 - 1855	1410 - 1755
D	2200 - 3050	2080 - 2880	1965 - 2725	1855 - 2575	1755 - 2435
E	3050 - 3600	2880 - 3400	2725 - 3215	2575 -3040	2435 - 2870
F	> 3600	>3400	>3215	>3040	>2870

Table 3.4 All-Way Stop LOS Criteria

TABLE 3.5
FREEWAY LEVEL OF SERVICE CRITERIA
FOR HIGHWAY 101

LEVEL OF SERVICE	PER LANE VOLUME (VPH)
A	0 to 720
B	721 to 1200
C	1201 to 1650
D	1651 to 1940
E	1941 to 2230
F	2231 or above

TABLE 3.6: VEHICULAR LEVELS OF SERVICE FOR FREEWAYS

Level of Service	Description	Volume/Capacity* (v/c) Ratio
A	Level of Service A describes a condition of free flow, with low volumes and high speeds. Traffic density is low, with speeds controlled by driver desires, speed limits, and physical roadway conditions. There is little or no restriction in maneuverability due to the presence of other vehicles, and drivers can maintain their desired speeds with little or no delay.	0.00-0.60
B	Level of Service B is in the higher speed range of stable flow, with operating speeds beginning to be restricted somewhat by traffic conditions. Drivers still have reasonable freedom to select their speed and lane of operation. Reductions in speed are not unreasonable, with a low probability of traffic flow being restricted.	0.61-0.70
C	Level of Service C is still in the zone of stable flow, but speeds and maneuverability are more closely controlled by the higher volumes. Most of the drivers are restricted in their freedom to select their own speed, change lanes, or pass. A relatively satisfactory operating speed is still obtained.	0.71-0.80
D	Level of Service D approaches unstable flow, with tolerable operating speeds being maintained though considerably affected by changes in operating conditions. Fluctuations in volume and temporary restrictions to flow may cause substantial drops in operating speeds. Drivers have little freedom to maneuver, and comfort and convenience are low, but conditions can be tolerated for short periods of time.	0.81-0.90
E	Level of Service E cannot be described by speed alone, but repre sents operations at even lower operating speeds (typically about 30 to 35 mph) than in Level D, with volumes at or near the capacity of the highway. Operations in this level are extremely unstable, because there are virtually no usable gaps in the traffic stream. Even minor disruptions can produce a serious breakdown with extensive queuing.	-0.91-1.00
F	Level of Service F describes forced or breakdown flow at low speeds (less than 30 mph), in which the freeway acts as storage for queues of vehicles backing up from a restriction downstream. Speeds are reduced substantially and stoppages may occur for short or long periods of time because of downstream congestion. In the extreme, both speed and volume can drop to zero.	1.00+

* Capacity is defined as Level of Service E.

SOURCE: Environmental Science Associates, Inc. from information in the Highway Capacity Manual, Special Report 87, Highway Research Board, 1965.

Given the non-standard geometries (the existing southbound outer lane (6th lane) drops approximately half way between the SFIA southbound on-ramp and the Millbrae off-ramp), and given the observed increase in freeway capacity since the data used to develop the weaving analysis procedure was collected, we recommend additional empirical analysis of this weaving section be made during the preliminary engineering if Caltrans is still concerned with this weaving section based on the alternative selected.